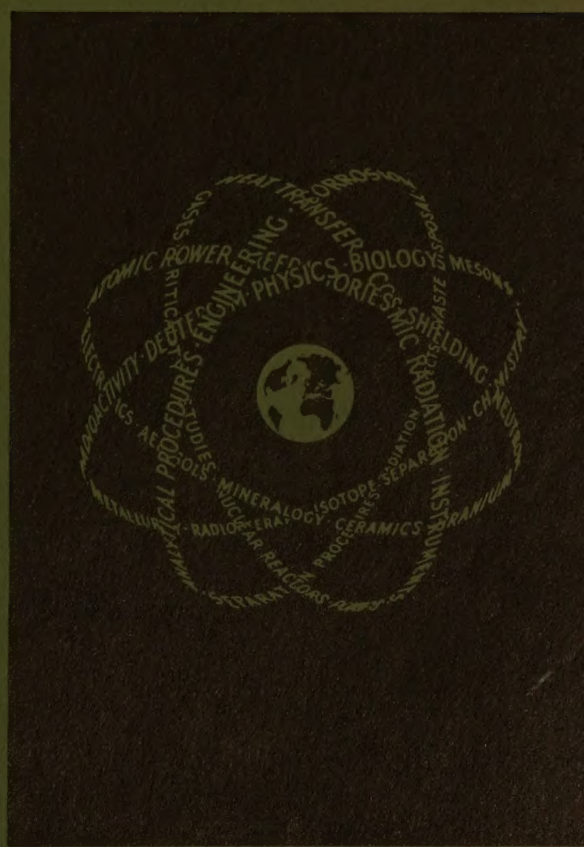
NUCLEAR SCIENCE ABSTRACTS



October 31, 1960

Volume 14 Number 20
Abstracts 20044–21181

UNITED STATES ATOMIC ENERGY COMMISSION

Office of Technical Information

USAEC DEPOSITORY LIBRARIES

Collections of USAEC reports are maintained in the libraries of the organizations listed below for reference use by the general public. Facilities for making photocopies are available. The USAEC also makes available through these libraries atomic energy reports of countries other than the U.S. that are abstracted in NSA.

ALABAMA
Auburn, Auburn University
Birmingham, Public Library

ARIZONA
Tucson, University of Arizona

ARKANSAS
Fayetteville, University of Arkansas

CALIFORNIA
Berkeley, University of California
Los Angeles, University of California
Menlo Park, Stanford Research Institute
San Diego, Public Library

COLORADO
Denver, Public Library

CONNECTICUT
New Haven, Yale University

DELAWARE
Newark, University of Delaware

DISTRICT OF COLUMBIA
Washington, Library of Congress

FLORIDA
Coral Gables, University of Miami
Gainesville, University of Florida

GEORGIA
Atlanta, Georgia Institute of Technology

HAWAII
Honolulu, University of Hawaii

ILLINOIS
Chicago, John Crerar Library
Chicago, University of Chicago
Evanston, Northwestern University
Urbana, University of Illinois

INDIANA
Indianapolis, Public Library
Lafayette, Purdue University

IOWA
Ames, Iowa State University

KANSAS
Manhattan, Kansas State University

KENTUCKY
Lexington, University of Kentucky
Louisville, University of Louisville

LOUISIANA
Baton Rouge, Louisiana State University
New Orleans, Tulane University

MARYLAND
Baltimore, Johns Hopkins University
College Park, University of Maryland

MASSACHUSETTS
Cambridge, Harvard University
Cambridge, Massachusetts Institute of Technology

MICHIGAN
Ann Arbor, University of Michigan
Detroit, Public Library

MINNESOTA
Minneapolis, University of Minnesota

MISSOURI
Kansas City, Linda Hall Library
Rolla, University of Missouri School of Mines and Metallurgy
St. Louis, Washington University

MONTANA
Bozeman, Montana State College

NEVADA
Reno, University of Nevada

NEW JERSEY
Princeton, Princeton University

NEW MEXICO
Albuquerque, University of New Mexico

NEW YORK
Buffalo, University of Buffalo
Ithaca, Cornell University
New York, Atomic Industrial Forum, Inc.
New York, Columbia University
New York, Public Library
Rochester, University of Rochester
Schenectady, Union College
Syracuse, Syracuse University
Troy, Rensselaer Polytechnic Institute

NORTH CAROLINA
Charlotte, Charlotte and Mecklenburg County Public Library
Durham, Duke University
Raleigh, North Carolina State College

OHIO
Cincinnati, University of Cincinnati
Cleveland, Public Library
Columbus, Ohio State University
Toledo, University of Toledo
Youngstown, Youngstown University

OKLAHOMA
Stillwater, Oklahoma State University

OREGON
Corvallis, Oregon State College
Portland, Reed College

PENNSYLVANIA
Philadelphia, University of Pennsylvania
Pittsburgh, Carnegie Library
University Park, Pennsylvania State University

PUERTO RICO
Rio Piedras, University of Puerto Rico

RHODE ISLAND
Providence, Brown University

SOUTH CAROLINA
Columbia, University of South Carolina

TENNESSEE
Knoxville, University of Tennessee
Memphis, Public Library
Nashville, Joint University Libraries

TEXAS
Austin, University of Texas
College Station, Agricultural and Mechanical College of Texas
Dallas, Southern Methodist University
Houston, Rice Institute
San Antonio, Public Library

UTAH
Salt Lake City, University of Utah

VIRGINIA
Blacksburg, Virginia Polytechnic Institute
Charlottesville, University of Virginia

WASHINGTON
Pullman, Washington State University
Seattle, University of Washington

WEST VIRGINIA
Morgantown, West Virginia University

WISCONSIN
Madison, University of Wisconsin
Milwaukee, Public Library

WYOMING
Laramie, University of Wyoming

NUCLEAR SCIENCE ABSTRACTS

A Semimonthly Publication of the United States Atomic Energy Commission Office of Technical Information

PURPOSE AND SCOPE

Nuclear Science Abstracts (NSA) serves scientists and engineers interested in the field of atomic energy by providing abstracts of the literature on nuclear science and engineering as well as immediate and detailed indexes to that literature.

NSA covers (1) research reports of the United States Atomic Energy Commission and its contractors; (2) research reports of government agencies, universities, and industrial research organizations on a world-wide basis; (3) translations, patents, books, and articles appearing in technical and scientific journals.

ARRANGEMENT OF ABSTRACTS

Abstracts are arranged according to broad subject categories as illustrated by the Contents (page iii). A new system of subject categories has been introduced in Volume 14.

INDEXES

Indexes in Individual Issues

Each issue of *NSA* includes personal and corporate author, subject, and report number indexes. Report numbers are also indicated in the author and subject indexes. The author indexes include "short" titles of the items indexed. The Report Number Index provides information on the availability of the reports.

Cumulated Indexes

The indexes included in the individual issues are cumulated quarterly, semiannually, and annually. A cumulated report number, author, and subject index covering Vols. 1 through 4 (July 1948–1950) is included in the bound Vol. 4 which is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. ($6.00). A subject and author index covering Vols. 5 through 10 (1951–1956) is available from the Superintendent of Documents ($5.25).

A cumulated report number index to *NSA* through Vol. 13 (1959) and to its predecessor, *Abstracts of Declassified Documents*, has been issued separately as report TID-4000, 5th Ed., *Public Availability of Reports Abstracted in Nuclear Science Abstracts*. This report is available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. ($5.00).

AVAILABILITY OF *NSA*

Sale

The semimonthly abstract issues and the four cumulated-index issues of *Nuclear Science Abstracts* are available postpaid on subscription and in single copy from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at the prices indicated below:

Semimonthly issues. Annual subscription rate: $18.00, domestic; $22.50, foreign. Price per single copy: $1.25, domestic; 25 per cent extra for foreign mailing.

Cumulated-index issues. Annual subscription rate: $15.00, domestic; $17.50, foreign. Price per single copy varies according to the number of pages.

Domestic subscription rates apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.

Foreign subscription rates apply to Argentina, Brazil, British and French Guiana, Surinam, British Honduras, and all other countries throughout the world.

Exchange

NSA is also available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Technical Information Extension, U. S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tennessee.

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Journal articles, books, and other privately published materials are not available from the AEC. Detailed information on obtaining reports and translations is given in the introduction to the Report Number Index.

U. S. Patents

Copies of U. S. patents may be ordered from the U. S. Patent Office, Department of Commerce, Washington 25, D. C. ($0.25 per copy).

United Kingdom Patents

Copies of United Kingdom patents may be ordered from The Patent Office, 25, Southampton Buildings, London W.C.2, England ($0.49 per copy).

Use of funds for printing this publication has been approved by the Bureau of the Budget, July 29, 1960.

CONTENTS

Volume 14, Number 20, October 31, 1960

Legal Notice

NUCLEAR SCIENCE ABSTRACTS

Volume 14 Number 20 October 31, 1960

GENERAL AND MISCELLANEOUS

20044 HW-62000

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PLUTONIUM RECYCLE PROGRAM ANNUAL REPORT FISCAL YEAR 1959. J. M. Atwood and W. A. Snyder, eds. Oct. 15, 1959. 134p. Contract AT(45-1)-1350. OTS.

Reactor performance data were correlated with overall fuel cycle costs to determine the worth of Pu in a variety of situations. For recycle operation with natural U feed, a relationship was developed between fuel exposure level and thermal utilization as a function of the reactor parameter, k_∞/ϵ. The economics of the Pu fuel fabrication for some two-reactor cycles vs. a reactor employing a self-sustaining recycle is discussed. A program for charging, discharging, cooling, processing, and refabrication of PRTR elements was developed using improved procedures for calculating Pu spike burnup rates. Fission cross sections were measured for Np^{237}, Am^{241}, and Pu^{241}. Lattice parameter measurements of rod clusters of UO_2 and mixtures of Al–Pu alloy and UO_2 rods were completed for the Physical Constants Testing Reactor. Nuclear safety studies were conducted in the fabrication, storage, and transportation of Pu–Al PRTR fuel elements. Physical and mechanical property measurements were made of Al–Pu alloys up to 15 wt. % Pu. Diffusion rates of Pu through Al were determined up to 600°C. The results of irradiation tests on rods, capsules, clusters, and other geometric forms of UO_2 elements in the MTR, ETR, Vallecitos Boiling Water Reactor, and Hanford Reactors are discussed. Thermal conductivity measurements of both irradiated and unirradiated UO_2 rods were made. Techniques for etching and autoclaving Zircaloy process tubes and fuel jackets were developed. The process consists of etching in HNO_3–HCl solution, $Al(NO_3)_3$ bath, water rinsing, and exposure to steam at 400°C and 115 psi. The conditions for the hydriding of Zircaloy and its effects on the properties of the metal were investigated. The applicability of the Zirflex process (NH_4F–NH_4NO_3) by dissolution of Zircaloy fuel cladding was confirmed. An anion exchange process was developed for Pu recovery from aqueous nitrate solutions. The distribution of U and Pu between metal and salt phases in the Al–AlCl–KCl system was investigated at 725°C. (For preceding annual report see HW-58000.) (C.J.G.)

20045 ORNL-1359

Oak Ridge National Lab., Tenn.

SOLID STATE DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING AUGUST 10, 1952. J. T. Howe, ed. Jan. 30, 1953. Decl. June 29, 1960. 54p. Contract W-7405-eng-26. OTS.

Radiation metallurgy studies on the creep of Inconel under irradiation and the effects of radiation on thermocouples are reported. Neutron spectral measurements were made in the LITR and in the ORNL Graphite Reactor. Engineering properties studies include: cause of plugging in the liquid-Na loop, standardization of flowmeters, and LITR Na stress-corrosion loop design. The fate of Xe^{135} produced by fission in the fused-fluoride reactor fuels was determined. The radiation stability of Cu phthalocyanine was investigated. A dynamic fuel testing assembly was designed. Corrosion of Inconel by a fluoride eutectic is reported. An apparatus is suggested to study corrosion effects of protons at various energies. The low-temperature bombardment of Ge in the ORNL Graphite Reactor and radiation effects in KCl crystals are reported. Radiation-induced changes in plastics, elastomers, and Cu single crystals are discussed. (For preceding period see ORNL-1301.) (L.M.T.)

20046 TID-8202

American Municipal Assn., Washington, D. C.

THE COMMUNITY IMPACT OF PEACEFUL APPLICATIONS OF ATOMIC ENERGY. Harold Sandbank. 86p. OTS.

This study of the Community Impact of Peaceful Applications of Atomic Energy was undertaken to promote understanding of national problems that affect municipalities and to encourage the development of municipal programs directed toward solution of these problems in keeping with national interest. (W.L.H.)

20047

THE ROLE OF NUCLEAR ENERGY IN THE SWISS ECONOMY. A. Gardel. Neue Technik 2, No. 2, 70-5 (1960) Feb. (In French)

A view is given about the situation in the field of energy supply in Switzerland. This is followed by a discussion on the possibilities of nuclear energy in this country. The construction of hydroelectric plants must be developed as far as possible. The industrial and economic importance of nuclear energy for the Swiss economy is then discussed. (auth)

20048

ORGANIZATION FOR ISOTOPE PRODUCTION IN FRANCE. P. Tempus (Reaktor A. G., Würenlingen, Switzerland). Neue Technik 1, No. 4, 9-18(1959) Aug. (In German)

The basis of the production of radioisotopes is discussed. Moreover, the organization and the method of production of isotopes in the French Nuclear Centre at Saclay are described. (auth)

20049

LONG-RANGE DETECTION OF FRENCH NUCLEAR TESTS OF 1960. R. L. Patterson, Jr. and L. B. Lockhart, Jr. (U. S. Naval Research Lab., Washington, D. C.). Science 132, 474(1960) Aug. 19.

With a relatively small number of strategically located ground-level air-filter stations, it has been possible to detect the presence of radioactive debris from the French nuclear test of February 1960 at a great distance from the test site, and to obtain data on the time of arrival of this debris and the extent of its north-south spread. (auth)

20050

RADIOACTIVITY FOR PHARMACEUTICAL AND ALLIED RESEARCH LABORATORIES. Abraham Edelmann, ed. New York, Academic Press, 1960. 179p. $6.00.

A symposium was held on the uses of radioactivity in pharmaceutical and allied research laboratories. Included are discourses on: radiobiology as a research tool; electron sterilizing processes; bioassay for granulocytopenia; usefulness of radioactivity in pharmaceutical and allied sciences; determination of sterols in natural products; analyses of antibiotics and insecticides; product development and evaluation; drug absorption, distribution, and excretion; radiobiochemistry in the pharmaceutical industry; use of isotopes in soap, detergent, and cosmetic research; and the isotope development program of the AEC. The symposium brought to light many of the potential uses of isotopes in this industry. It indicated how isotopes can be used in analysis, product evaluation, radiation sterilization, and process control. (B.O.G.)

20051

BUSINESS STATISTICS ON THE ATOMIC INDUSTRY 1954-1958. A FORUM SURVEY. Edwin A. Wiggin, ed. New York, Atomic Industrial Forum, Inc., 1960. 36p. $3.50.

A survey is given of the commercial and other nongovernment activities in atomic energy development and application for the period 1954 to 1958. Over $224 million, ~$124 million in private monies and $100 million in government monies, were spent for research and development by 191 of the companies and institutions participating in the survey. Approximately 45% of the $224 million was reported for reactor design and development. An estimated $1.5 billion worth of nuclear reactors, components, materials, and services have been delivered by American industry. Over $650 million worth of nuclear products and services are estimated to have been delivered during 1958. Facilities for milling and processing uranium ores accounted for ~31% of the estimated $465 million of private funds spent for capital investment. (B.O.G.)

BIOLOGY AND MEDICINE

General and Miscellaneous

20052 HW-64112

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

METABOLISM OF W^{185} IN THE RAT. J. E. Ballou. Mar. 10, 1960. 13p. Contract AT(45-1)-1350. OTS.

Investigation of the distribution and retention of W^{185} in rats suggests that the critical organ and certain metabolic parameters may be different from those recommended by the International Commission on Radiological Protection. The effect of these changes on the calculated maximum permissible concentration in water is relatively minor. (auth)

20053 NYO-4870

Johns Hopkins Univ., Baltimore. Inst. for Cooperative Research.

THE METABOLISM AND FUNCTIONAL SIGNIFICANCE OF COBALT-PROTEINS. Final Technical Report. [195?]. 106p. Contract AT(30-1)-933. OTS.

The significance of cobalt and cobalto-proteins in metabolism was investigated. The role of the cobalt-containing Vitamin B_{12} was studied. Data are included from investigations of the role of cobalt in plant metabolism, the chemical fractionation of metabolically formed cobalt complexes and the role of Vitamin B_{12}, and the analytical separation of cobalt compounds. The function of trace elements in nutrition and intermediary metabolism in animals is discussed. (C.H.)

20054 ORNL-2957

Oak Ridge National Lab., Tenn.

AN EMPIRICAL STUDY OF THE SAMPLING DISTRIBUTIONS OF SOME DISEASE INCIDENCE ESTIMATES (thesis). George J. Atta. July 19, 1960. 71p. Contract W-7405-eng-26. OTS.

Submitted to the Univ. of Tenn.

A statistical method is described for the estimation of disease incidences in populations subject to competing risks. A random sample of N animals from an infinite population is observed until all animals in the sample have died. At the time of death, the cause of death is recorded. The observation period is divided into n intervals, not necessarily of equal length, and the number of animals dying from each cause of death is calculated for each time interval. It is desired to estimate the disease incidences in a population in which one of the diseases has been eliminated as a cause of death. The estimation is to be performed with a sample from a population in which all causes of death are operating. An estimation procedure developed by Kimball is discussed. This method is based on the maximum likelihood estimates of the parameters of a distribution very similar to the multinomial distribution. In an attempt to improve upon Kimball's approximate formula for the variances of the estimates, a true asymptotic variance formula is derived. To provide some information on the small sample properties of the estimates, a large-scale random sampling experiment was designed and carried out on the ORACLE. This empirical study reflected favorably upon the estimation procedure. (C.H.)

20055 TID-5955

Sloan-Kettering Inst. for Cancer Research, New York.

BIOLOGICAL EFFECTS OF RADIATION, AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. Semiannual Progress Report for November 1, 1959 through April 30, 1960. May 1, 1960. 70p. Contract AT(30-1)-910. OTS.

An electron spin resonance spectrometer was placed in operation and used to examine a large number of carcinogenic aromatic hydrocarbons for negative free radical activity. Results are reported in studies on the metabolism of calcium-47 in patients with bone lesions; energy distributions of the electrons initially set in motion in water by gamma rays; tracer studies using carbon-14 to determine the effects of changes in thyroid function on the metabolism of hormonal steroids; growth inhibition of mammalian cells in tissue cultures which contain fluorinated pyrimidine nucleosides; and the localization of tritium-labeled nucleic acid precursors. Preliminary data are presented from a survey of approximately 55 patients who have received radioiodine in the treatment of metastatic thyroid cancer since 1944. The syntheses of mercaptopurine nucleotides was continued and preliminary experiments were carried out on the syntheses of o-2, 2'-cyclocytidine and 5-ribosyluracil. Physical studies on purified ribonucleoprotein from rat liver were continued. Attempts were made to obtain antibodies with

purine or adenine specificity. Desoxyribonucleic acid was separated into five or six fractions by means of the Swag deproteinization method. Educational activities of the Sloan-Kettering Institute are reviewed. (C.H.)

20056 TID-6113

Beth Israel Hospital, [New York.]
[SUMMARY OF STUDIES COMPLETED ON THE LONG-TERM EFFECTS OF I^{131} ON THE THYROID GLAND]. Herrman L. Blumgart. June 7, 1960. 13p. Contract AT-(30-1)-916. OTS.

Progress is reported in a survey of the long-term effects of iodine-131 on the thyroid gland. Case histories are included for patients who received radioiodine to induce myxedema. Preliminary results are reported from studies of thyroid function in 28 patients with severe pulmonary insufficiency in preparation for subsequent therapy with radioactive iodine, 41 determinations of red blood cell uptake in 22 patients with CO_2 retention, and studies of the mechanism by which iodine-131 induced myxedema ameliorates angina pectoris. (C.H.)

20057 UCRL-9135

California. Univ., Berkeley. Lawrence Radiation Lab.
BIO-ORGANIC CHEMISTRY QUARTERLY REPORT [FOR] DECEMBER 1959, JANUARY AND FEBRUARY 1960. J. A. Bassham, ed. Mar. 18, 1960. 52p. Contract W-7405-eng-48. OTS.

Study of soluble green leaf protein (Fraction I) is reported in which chloroplast fragments containing particles of 100-A diameter were observed. Further study of these particles to determine their function is in progress. Studies of steady-state photosynthesis and growth in Chlorella pyrenoidosa were continued, and experiments to determine rates of amino acid synthesis are in progress. Algae nutrient solutions for these experiments are being studied. Experiments are described in which the role of glycolic acid in photosynthetic carbon metabolism in CO_2 fixation is being studied. Glycolic acid was administered to Chlorella photosynthesizing in the presence of $C^{14}O_2$. A companion experiment was run in which acetate was the source of C^{12}. Tabulated data are included which indicate that both glycolate and acetate reduce the total fixation. Glutamic acid degradation studies are reported which were carried out to learn the way in which this compound is formed when $C^{14}O_2$ is fed to photosynthesizing algae. Alternative degradation methods are discussed. In a study of the chemical effects of ionizing radiation on nucleotides, samples of uridylic acid were exposed to gamma radiation; resulting decomposition products are discussed. Experiments in which the degradation of toluene, formed when solid benzene is irradiated with C^{14} ions was partially completed. Energy values for carbon atom ring distribution are discussed and possible reactions are examined. A technique was developed for rapid processing of single samples in which $C^{14}O_2$ is bound, by means of a quaternary ammonium base, into a form suitable for liquid scintillation counting. The method was also extended for application to the assay of $C^{14}O_2$ in organic material combustion products. Experiments to test the hypothesis that increased training and more complete experience can influence rat brain cholinesterase (ChE) activity are described. Rats were subjected to experimental conditions, after which their cortical and subcortical ChE activity was determined. Analysis of results leads to the conclusion that environmental stimulation and training account for the difference in the pattern of ChE activity between the cortex and the subcortex. Data provide further indication that the cortical Te subcortical ratio of activity is more sensitive to environmental influences than are the primary ChE measures. A previously reported experiment on the effects of D_2O on Drosophila was conducted in which the former results were not duplicated. Comparative data are included, and it is noted that the experiment is being repeated. (For preceding period see UCRL-9041.) (J.R.D.)

20058 UR-573

Rochester, N. Y. Univ. Atomic Energy Project.
THE ACCUMULATION OF Po^{210} IN THE RAT DURING MULTIPLE INHALANT EXPOSURES. Harry L. Berke and Alfred C. Di Pasqua. June 9, 1960. 35p. Contract W-7401-eng-49. OTS.

A group of Wistar-Rochester strain rats was exposed to an aerosol of sodium chloride contaminated with polonium for ten successive days, 5 hours daily. The pattern of accumulation of the nuclide in the whole body and in the lung is reported. Some calculations pertinent to the evaluation of the maximal permissible air concentration of Po^{210} based on these data are presented. (auth)

20059 JPRS-2286

MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya Volume IV, No. 1, 1959. 158p. OTS.

20060 JPRS-2286(p.96-106)

THE INFLUENCE OF POLYPHOSPHATES ON THE DISTRIBUTION OF Ce^{144}. Yu. I. Moskalev. Translated from Med. Radiol. 4, No. 1, 65(1959).

The immediate administration of hexametaphosphate was found to reduce the absorption of cerium-144 by the liver and skeleton. Trimetaphosphates did not influence the distribution of cerium-144 in rats. (C.H.)

20061

EFFECT OF RADON AND RADIUM ON THE DRIVE ACTIVITY OF THE ILEUM OF THE GUINEA PIG. M. Fontan, J. Dujardin, and J. Lecerf. Compt. rend. soc. biol. 154, 126-30(1960). (In French)

Within the framework of a general study on the pharmacodynamic activity of thermal waters, the effect of radon and a radium salt on the ileum activity of the guinea pig was investigated. Radon appears to cause an augmentation of the amplitude of the spontaneous motions and a slowing of the rhythm. For the study of radium bromide the salt is injected intraperitoneally and the animal is sacrificed 12 to 96 hours later by bleeding. The pendular movements of the isolated terminal ileum were observed, and acetylcholine-atropine tests were performed. An attempt was made to evaluate the quantities of radium bromide fixed by the intestine as a function of the dose injected. (J.S.R.)

20062

SOME PROPERTIES OF RADIATION RESISTANT DERIVATIVES OF L STRAIN MOUSE CELLS. J. F. Whitfield and R. H. Rixon (Atomic Energy of Canada Ltd., Chalk River, Ont.). Exptl. Cell Research 20, 242-4(1960) June.

No evidence was found to relate radiation resistance in L strain mouse cells to increased catalase activity, glycolysis, or rate of oxygen consumption. Only two cell properties have hitherto been observed to be consistently associated with radiation resistance in these mouse cells. These are the absence of a long metacentric chromosome and a lower modal chromosome number in the resistant derivatives of the sensitive lines. (auth)

20063

ON THE MECHANISM OF THE LUMINESCENCE OF ALKALI-HALIDE CRYSTALS ACTIVATED BY Ga^{+}, Ge^{++}, In^{+}, Pb^{++}, Sn^{++}, Tl^{+}. Ch. B. Lushchik (Inst. of Physics and Astronomy, Academy of Sciences, Estonian, SSR). Izvest. Akad. Nauk Eston. S.S.R. 8, 287-95(1959). (In Russian)

A many-sided investigation was made of potassium

halide crystals activated by six mercury-like ions In^+, Ga^+, Tl^+, Sn^{2+}, Ge^{2+}, and Pb^{2+}. The nature of the luminescence centers, the mechanism of recombination luminescence, and the mechanism of energy migration in these phosphors are discussed. (auth)

20064

DIFFERENTIAL ANALYSIS OF THE STAGES OF HEPATIC EXCRETORY FUNCTION WITH GAMMA EMITTING ISOTOPES. I. METHODS AND VALIDATION. Edwin Englert, Jr., Belton A. Burrows, and Franz J. Ingelfinger (Massachusetts Memorial Hospitals, Boston; Boston Veterans Administration Hospital; and Boston Univ.). J. Lab. Clin. Med. 56, 181-92(1960) Aug.

Radioactivity over the liver after intravenous injection of I^{131}-labeled rose bengal (RIRB) increased rapidly, then plateaued for a brief period, and finally declined. The initial and final phases were exponential processes and could be quantitated as rate phenomena of uptake and excretion. When uptake rate was measured simultaneously with the rate of removal of dye from the blood and excretion rate with the rate of accumulation of dye in duodenal contents, there was good correlation. Rates of uptake and excretion were reproducible in individual subjects, provided that collimation and positioning were controlled carefully. With the same provision, evidence was obtained by studying patients with surgically removed gall bladders who were undergoing constant removal of duodenal contents via an indwelling gastroduodenal tube that radiation from dye in the gall bladder and intestines did not affect results significantly. A linear dose-response relationship resulted from continuous measurement of hepatic radioactivity during repeated intravenous injections of I^{131}-labeled human serum albumin (RISA). Calculations based on this relationship and the plasma removal rate of RIRB indicated the radioactivity of I^{131}-labeled rose bengal in hepatic blood affected the measured hepatic uptake rate of dye only negligibly. It is concluded that the technique of external measurement of RIRB in the liver is a reproducible, meaningful method for quantitating rate phenomena of hepatic excretion under carefully controlled conditions. (auth)

20065

DIFFERENTIAL ANALYSIS OF THE STAGES OF HEPATIC EXCRETORY FUNCTION WITH GAMMA EMITTING ISOTOPES. II. ATTEMPTS TO ALTER RATE PHENOMENA. Edwin Englert, Jr., Belton A. Burrows, and Franz J. Ingelfinger (Massachusetts Memorial Hospitals, Boston; Boston Veterans Administration Hospital; and Boston Univ.). J. Lab. Clin. Med. 56, 193-206(1960) Aug.

Radioactivity over the liver was measured after the intravenous injection of radioiodinated rose bengal (RIRB) or radioiodinated Diodrast (RID), and the rates of hepatic uptake and excretion of the labeled dye were calculated. Intravenous dehydrocholate or sulfobromophthalein administered before the uptake phase slowed RIRB uptake for a limited time. Whether or not the timing of injection permitted the effect on uptake rate to occur, subsequent excretion of RIRB was slowed. Since delayed uptake did not explain the depressed excretion rate, the deceleration was attributable to competition which affected a storage mechanism. Competition at several steps during hepatic excretion of RIRB, sulfobromophthalein, and dehydrocholate suggested common metabolic pathways for these substances in the liver. Large doses of dehydrocholate given during the stage of RIRB excretion accelerated the rate of RIRB excretion, presumably by inducing hydrocholeresis. Such administration of hydrocholeretic substances during the excretion stage of RIRB accelerate the rate limiting mechanism which normally determines excretion half-time, thus permitting a new rate-limiting mechanism which affects the stage of hepatic storage to be measured. Rates of RID uptake-excretion were faster than those of RIRB, and different hepatic excretory mechanisms for the two compounds were indicated by the studies. (auth)

20066

ORGANIZATION OF RADIOLOGICAL SERVICE FOR THE POPULATION. E. I. Vorob'ev. Med. Radiol. 5, No. 5, 3-10(1960) May. (In Russian)

The principal problems of organization of radiological service for the population in the USSR are discussed. (auth)

20067

THE USE OF RADIOACTIVE ISOTOPES AND IONIZING RADIATION IN THE TREATMENT OF MALIGNANT TUMORS. A. V. Kozlova. Med. Radiol. 5, No. 5, 10-16(1960) May. (In Russian)

On the basis of extensive data, a report is given on the employment of radioactive isotopes and ionizing radiation in the treatment of malignant tumors. (auth)

20068

RADIOPHOSPHORUS THERAPY OF PATIENTS AFFECTED WITH POLYCYTHEMIA VERA AND LYMPHOGRANULOMATOSIS. N. P. Makletsova (Leningrad Inst. of Medicine). Med. Radiol. 5, No. 5, 26-9(1960) May. (In Russian)

Radiophosphorus is the best remedy in the treatment of polycythemia vera. It would be used fractionally in low doses with special consideration of the specificity of the reaction in each individual patient; constant registration of the content of hemoglobin, erythrocytes, leukocytes, and thrombocytes is imperative. Prior to radiophosphorus therapy bloodletting is necessary in order to prevent thrombosis and hemorrhages during the first months following the treatment, when P^{32} has not yet exerted its action. In diffuse lymphogranulomatosis radiophosphorus may prove helpful as a supplementary agent in roentgen therapy, which acts upon all the nodes. In such instances roentgen therapy could be used to act upon the remaining lymph nodes, which threaten the life of the patient. If roentgen therapy proved ineffective in individual lymphogranulomatous nodes the employment of radiophosphorus may prove beneficial. (auth)

20069

THE ABSORBABILITY OF IONIZING RADIATION BY PATIENTS IN ROENTGENODIAGNOSTIC STUDIES. V. I. Abgarov, S. S. Fatalieva, and F. A. Alieva (Azerbaidzhan Narimanov Inst. of Medicine, USSR). Med. Radiol. 5, No. 5, 33-7(1960) May. (In Russian)

The dose of ionizing radiation absorbed by different organs during roentgenodiagnostic examinations of patients is assessed. Measurements were performed with an individual dosimeter of the KID-1 type. In order to establish the data under consideration in rads, three measurements were made: two on the object and one on the phantom. On the basis of average data of combined measurements, tables were compiled presenting doses of ionizing radiation in rads absorbed by respective organs. The data obtained divulge that during roentgenographic examinations the organs absorb considerably lower quantities of radiant energy than in roentgenoscopy. During roentgenographic studies of the region of the small pelvis the genitalia (appendages, scrotum) should be protected from the deleterious effect of ionizing radiation. Roentgenoscopy of thoracic organs in children under three should be replaced by roentgenography. The safety problem could be eliminated if apparatus with electronic-radiant amplification of the luminescence of screens are introduced widely into practice. (auth)

20070

COMPARATIVE DATA ON THE PERMEABILITY OF THE

HEMATOENCEPHALIC BARRIER FOR ARTIFICIAL RADIOACTIVE ISOTOPES OF PHOSPHORUS AND BROMINE. M. Ya. Maizelis (State Research Inst. of Psychiatry, Ministry of Health, USSR). Med. Radiol. 5, No. 5, 52-5(1960) May. (In Russian)

In experiments on rabbits and white rats, with P^{32} and Br^{82}, the dynamics of isotope penetration into the cerebrospinal fluid from the blood and vice versa; their accumulation in various portions of the brain; and the rate of concentration diminution in the blood following intravenous administration of isotopes; were studied. (auth)

20071

CERTAIN PROBLEMS OF RADIATION HYGIENE IN DEPARTMENTS WHERE RADON THERAPY IS DISPENSED. I. I. Gusarov (Moscow Order of Lenin, Sechenov Inst. of Medicine). Med. Radiol. 5, No. 5, 56-62(1960) May. (In Russian)

An experimental investigation was made of the air radioactivity in departments where radon therapy is effected. It was established that during the process of preparing an aqueous radon solution in these departments there occurs a considerable pollution of air with radon and its by-products. Recommendations are made for experimentally checking of technological and sanitary-hygiene measures, which will ensure a radical improvement of labor conditions in radon-therapy departments. Hygienic recommendations relative with the internal designing of such departments are given. (auth)

Biochemistry, Nutrition, and Toxicology

20072 UR-570

Rochester, N. Y. Univ. Atomic Energy Project. TOXICOLOGY OF BERYLLIUM: A BIBLIOGRAPHY. Elliot Dole Hutchinson, Robert D. Armstrong, Elliott A. Maynard, and Harold C. Hodge. Apr. 29, 1960. 78p. Contract W-7401-eng-49. OTS.

Sources searched for the included references are Chemical Abstracts, Biological Abstracts, University of Rochester Report Catalog, Beryllium Toxicology Literature Search by Sachs and Ballantine, Bibliography on the Toxicology of Beryllium by Riese and Hendrickson, and medical literature lists. Report and published literature are included. 670 references. (J.R.D.)

20073

DETECTION OF CALCIUM-45 IN BONE SOLUTIONS. Donald E. Pickering, Helen L. Reed, and Robert L. Morris (Univ. of Oregon Medical School, Portland). Anal. Chem. 32, 1214-15(1960) Aug.

An apparatus, consisting of a spiral capillary plastic phosphor of volume 0.2 ml and associated counting equipment, was constructed for counting calcium-45 in inorganic solutions of bone. Salts of Ca and Sr are easily removed from the phosphor, but iodine-131 compounds were found to be difficult to remove. The phosphor has a sensitivity good for β particles with energies up to 0.01 to 0.3 Mev, but poor for β particles with energies above 0.7 Mev and γ radiation. The efficiency of the overall system is ca. 11%, and the working efficiency ca. 7.2%. This system is stated to have increased efficiency, eliminated self-absorption, and reduced sample preparation time as compared with solid counting systems. (D.L.C.)

20074

STUDIES ON THE METABOLISM AND PERMISSIBLE LEVEL OF RADIOACTIVE ZINC Zn-65. Tsuguhiko Shiraki (Osaka City Univ.). Ôsaka Shiritsu Daigaku Igaku Zasshi 8, 1415-40(1959) Sept. (In Japanese)

Results are tabulated from a study of the metabolism and tissue distribution of zinc-65 in rats. The maximum permissible dose of zinc-65 is discussed for different organs of the body. (C.H.)

Fallout and Ecology

20075 A/AC.82/G/L.361

Institut Pasteur. Institut National d'Hygiène, Paris and Strasbourg. Université. Institut de Physique Biologique.

EVOLUTION DE LA TENEUR DU LAIT ET DES VEGETAUX EN RADIOELEMENTS ARTIFICIELS DANS L'EST DE LA FRANCE (PERIODE DU 1er JANVIER 1958 AU 1er OCTOBRE 1959). (Artificial-Radioelement Content of Milk and Plants in Eastern France (January 1, 1958—October 1, 1959)). A. Chevallier and R. Schneider. June 9, 1960. 25p.

Procedures are described for the radiochemical analysis of milk and vegetation. Data are tabulated on the levels of radioactivity found in samples collected in eastern France between January 1958 and October 1959. (C.H.)

20076

MODERN PROBLEMS OF RADIOBIOLOGY. A. M. Kuzin (Inst. of Biological Physics, Academy of Sciences, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Biol. No. 3, 355-63(1960) May-June. (In Russian)

A review is presented of the major problems of modern radiobiology. Emphasis is laid on the studies in the primary and initial processes elicited in the living organism by irradiation as well as on the effect of nuclear radiations upon heredity and on the theoretical and practical significance of general physiological studies of the processes arising in the irradiated organism. Of exceptional significance to public health are the problems of radiation disease and the study of the mechanisms of distant radiation effects, first of all the malignization effect of radiation. Closely linked to this is the problem of biological and chemical protection from the harmful effect of radiation. A discussion is also presented of the problem of small radiation doses which becomes of particular importance with the progress of atomic industry. In conclusion, the use of radiation is considered in agriculture, medicine, and in those branches of industry which are dealing with raw material either of plant or animal origin. (auth)

20077

BIOLOGICAL AVAILABILITY OF STRONTIUM-90 FROM ATOMIC TESTS. FROM 50 TO 100 PERCENT IS AVAILABLE TO THE BIOSPHERE, DEPENDING ON THE IMMEDIATE ENVIRONMENT OF THE BOMB. E. A. Bryant (Los Alamos Scientific Lab., N. Mex.), G. A. Cowan, W. R. Heald, R. G. Menzel, R. F. Reitemeier, J. E. Sattizahn, and B. Warren. Science 132, 327-30(1960) Aug. 5.

The experiments described provide data concerning the solubility and biological availability of Sr^{90} in samples of airborne debris from atomic explosions in different environments. The experiments were designed to provide information on the incorporation of Sr^{90} in relation to the device yield and matrix material and to establish a simple test for Sr^{90} availability, as a parallel to the ammonium acetate method for determination of the exchangeable calcium content of soil. The collecting methods and preparation are discussed. Tabulations of the experimental results are included. (B.O.G.)

20078
STRONTIUM-90 IN MAN. IV. THE STRONTIUM-90 CONCENTRATION IN HUMAN BONE INCREASED IN 1958 AND 1959, WILL PROBABLY REACH A MAXIMUM IN 1960. J. Laurence Kulp, Arthur R. Schulert, and Elizabeth J. Hodges (Columbia Univ., Palisades, N. Y.). Science 132, 448-54(1960) Aug. 19.

The strontium-90 concentration in human bone continued to increase in 1958 and 1959 but the concentration in new bone probably will reach a maximum in 1960. The strontium-90 concentration in adult bone is independent of the age of the individual. The average for Western culture areas in the Northern Hemisphere in 1958 was about 0.20 micromicrocurie per gram of calcium, and in 1959, about 0.30 micromicrocurie. The average strontium-90 concentration for the whole skeleton of an individual may be estimated from the analysis of a single bone to within 10 to 15 percent if sufficient activity is present. The standard deviation for the strontium-90 concentration in fetuses or adults from a single metropolitan area is about 40 percent. The standard deviation for the average strontium-90 level in milk from several dozen stations in North America is also about 40 percent of the mean. These data permit an estimation of the distribution curve for 99 percent of the population of the United States. The maximum strontium-90 concentration is now found in one-year-olds. In 1959 this average value was 2.1 micromicrocuries per gram of calcium for Western culture areas. The concentration varies markedly with age, in a predictable manner. The discrimination factor from mother's diet to fetus appears to be about 12 against strontium as compared with calcium. The strontium-90 level in persons who were one year old in 1959 will drop rapidly if there is no further atmospheric contamination. In 1970 these individuals will carry 0.9 micromicrocurie per gram of calcium. The limited available data do not indicate any large difference in the distribution curves for rice-diet and Western culture areas. In a rice-diet area such as Thailand, however, the diet levels are approximately three times those in the United States per unit of fall-out. In general, because of differences in diet, strontium-90 concentrations in some tropical and Southern Hemisphere countries appear to be similar to concentrations in Western culture areas between latitude 30° and 70°N, despite the lower fallout rate in the tropics and the Southern Hemisphere. Previous predictions of strontium-90 levels in diet and bone from tests to date have been high, due to overestimates of the stratospheric reservoir and the stratospheric residence time and an underestimate of the importance of the rate of fall-out factor. Thus, the peak in the diet passed in 1959; the peak in growing bones will pass in 1960; and the equilibrium level will be lower than had been predicted by a factor of 5 to 10. This same factor applies to the long-term effect of a nuclear war insofar as the hazard from strontium-90 is concerned. (auth)

Radiation Effects on Living Tissues

20079 A/AC.82/G/L.341
Bordeaux. [Université].
RAPPORT SUR LE PROBLEME DES DOSES AUX GONADES RESULTANT DE L'UTILISATION MEDICALE DES RADIATIONS IONISANTES EN FRANCE. (Report on the Problem of the Gonad Dose Resulting from the Medical Use of Ionizing Radiation in France). [J]. Reboul. Feb. 25, 1960. 72p.

A study was made of the radiation dose to the gonads received by patients undergoing diagnostic radiography or radiation treatments in France. Data are tabulated and results are discussed. (C.H.)

20080 AD-232231
Jefferson Medical Coll., Philadelphia.
IMMUNITY AFTER IRRADIATION AND MARROW TRANSPLANTATION. Annual Report [for] March 1, 1959 to February 29, 1960. W. Paul Havens, Jr. 4p. Contract DA-49-007-MD-963.

The capacity of 36 Schick-negative patients with carcinoma to respond to a booster dose of diphtheria toxoid following roentgen radiation in amounts ranging from 3600 to 6000 r given in divided doses over 4 to 6 weeks was determined. Seven patients had no demonstrable increase in amounts of circulating antitoxin. Twenty-nine patients had an anamnestic response that was vigorous in a large percentage of them. These results suggest that the secondary immunologic response in patients with carcinoma treated with roentgen radiation may be inhibited or impaired in a small percentage of patients, while the majority would respond normally. Experiments concerned with the demonstration of antibody production by bone marrow cells following transfer to irradiated isologous and homologous mice confirmed preliminary results and indicate that isologous cells produced antibody over a 25-day period after transfer with little reduction in amount after the first week. Homologous cells made less antibody and had a more rapid decline in production. The capacity of transferred cells to produce antibody may be a method of measuring the life span of such cells. (auth)

20081 TID-6042
Indiana Univ. Foundation Research Div., Bloomington, Ind.
THE INFLUENCE OF RADIATION IN ALTERING THE INCIDENCE OF MUTATIONS IN DROSOPHILA. Progress Report on the Past Twelve Months and Renewal Proposal for the Period September 15, 1960 to September 14, 1961. H. J. Muller. May 31, 1960. 14p. Contract AT(11-1)-195. OTS.

Progress is reported in studies on the effects of radiation on the incidence of mutations in Drosophila. Results are summarized and the findings are interpreted. A list is included of papers published during the period. (C.H.)

20082 TID-6147
Wayne State Univ., Detroit. Animal Behavior Lab.
THE EFFECT OF PRENATAL X-IRRADIATION ON THE BEHAVIORAL DEVELOPMENT OF THE ALBINO RAT. Period covered: October 1, 1959 through September 30, 1960. Jack Werboff and Melvin R. Sikov. 15p. Contract AT(11-1)-821. OTS.

The preliminary data suggest that even the lowest level of prenatal irradiation (25 r) can effect certain behavioral processes in the developing offspring. The effect of irradiation appears also to be dependent upon the day of gestation irradiated. These tentative results warrant further exploration to consider the effects of prenatal radiation on other behavioral processes, and to determine what the lower limits of radiation may be at particular days of gestation. (auth)

20083 WT-1542
School of Aviation Medicine, Brooks AFB, Tex.
BIOLOGICAL EFFECTS OF NUCLEAR RADIATION ON THE MONKEY (MACACA MULATTA): TWO-YEAR EVALUATION. J. E. Pickering, D. B. Williams, G. S. Melville, Jr., A. A. McDowell, T. P. Leffingwell, and R. W. Zellmer. June 1959. 51p. Project 39.6 (Supplement 1) of Operation PLUMBBOB. OTS.

Macaca mulatta monkeys were exposed to prompt neutron and gamma radiation from two nuclear detonations. At a period roughly two years postirradiation, the survivors have been examined with respect to long-term effects. The present condition of the animals relative to clinical appearance, peripheral hematology, behavior, and cataractogenesis has been evaluated and compared with the acute effects that were noted and reported for the first 30 days following exposure. Recovery of erythroid indices in shot Wilson survivors was functionally complete by about 9 weeks postexposure, effected by production of larger hyperchromic erythrocytes with a normal hemoglobin concentration, and followed by a possible macrocytic hyperchromic anemia for the majority of the 63- to 540-day postexposure period. Similar phenomena were not observed in the lower-dose shot Fizeau survivors. Lymphocytes of the myeloid series were the last to evidence recovery; the single animal that died exhibited a unique lymphocytic hypoplasia, which suggests a differential effect on the precursor tissue. By about 100 days, when the myeloid recovery was essentially complete, only a depressed total leukocyte count reflected any long-term effect; relative populations of the component cells were normal. Shot Fizeau animals evidenced the depression/response pattern observed in the shot Wilson animals, but no long-term differences were apparent. The results with respect to behavior parameters include differences on preliminary Wisconsin General Test Apparatus training which support the hypothesis of a radiation-induced elevation of response threshold values, learning-performance differences in the male radiation dosage groups which are in accord with previous researches on other groups of monkeys, observed differences between male and female monkeys on both learning performance and free-cage behavior parameters, and a radiation-induced facilitation on difficult size discrimination problems. (auth)

20084 JPRS-2286(p.24-36)
THE INFLUENCE OF RADIOACTIVE PHOSPHORUS ON THE CONDITIONED REFLEX ACTIVITY OF DOGS. E. A. Airikyan (Ye. A. Ayrikyan), O. L. (D.) Gaske, and F. N. Serkov. Translated from Med. Radiol. 4, No. 1, 19-26 (1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9617.

20085 JPRS-2286(p.37-43)
THE EFFECT OF SINGLE X-IRRADIATION OF RABBITS IN THE FINAL DAYS OF PREGNANCY ON THE FUNCTIONAL STATE OF THE INTRAUTERINE FETUSES. N. A. Kalinina. Translated from Med. Radiol. 4, No. 1, 26-31 (1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9618.

20086 JPRS-2286(p.44-9)
THE EFFECT OF GAMMA-IRRADIATION IN SMALL DOSES ON THE SECRETORY AND MOTOR ACTIVITY OF THE STOMACH IN DOGS. E. G. Morgunov (Ye. G. Morgun), P. A. Sakun, T. I. Svistun, and M. P. Stanets. Translated from Med. Radiol. 4, No. 1, 31(1959).

Changes were observed in the motor and secretory activity of the stomach in dogs subjected to small chronic doses of gamma radiation over a 15-month period. The secretory activity of the gastric glands in response to food substances was depressed by the fifth month of irradiation, changes in periodic hunger contractions were observed after 6 months, and the evacuational function of the stomach was reduced by the 10th or 11th month. (C.H.)

20087 JPRS-2286(p.50-8)
THE INFLUENCE OF SINGLE X-IRRADIATION ON THE GROWTH OF CEREBRAL CAPILLARIES. E. (Ye.) N. Kosmarskaya and Yu. I. Barashnev. Translated from Med. Radiol. 4, No. 1, 35-41(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9619.

20088 JPRS-2286(p.72-6)
THE INFLUENCE OF X-IRRADIATION ON "CHRONIC" FOCI OF AUTOINFECTION. V. (B.) G. Avetikyan and A. G. Artemova. Translated from Med. Radiol. 4, No. 1, 50-3(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9622.

20089 JPRS-2286(p.127)
SOME FINDINGS ON THE INFLUENCE OF LOWERED BAROMETRIC PRESSURE ON THE COURSE OF INFLUENZA IN IRRADIATED MICE. V. P. Emaykina and O. P. Lebedeva. Translated from Med. Radiol. 4, No. 1, 83-5 (1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9628.

20090
INDUCED MUTATIONS IN PLANT CROPS. D. Roy Davies (Wantage Research Lab., Eng.). Atom No. 45, 13-19; 31-2(1960) July.

A lengthy discussion is presented on mutations radioinduced in plant crops, and many examples are given to illustrate every point. Radioinduced mutations in plants have two disadvantages: (a) large plant populations must be grown in order to obtain beneficial mutations, which even then may escape detection; (b) sterility or elimination of the cell containing the damaged chromosomes often results. Radiation used for mutations is divided between x and γ rays on the one hand and thermal and fast neutrons on the other; the neutrons have the higher relative biological efficiency. Chronic (low dose rate) irradiations have no advantage over acute (high dose rate) irradiations; moreover, equipment for the former is more expensive to construct. The role of physical, chemical, and biological factors in plant radiosensitivity is discussed: (1) Temperature. Seeds exposed at –190°C show much less damage than those irradiated at room temperature, and seeds immersed in 90°C water immediately after irradiation are similarly protected. (2) Water Content. Dry barley seeds are more radiosensitive than wetter ones, and long dry storage times are deleterious. (3) Chemical Factors. O_2, CO_2, and CO are found to enhance radiosensitivity, while N_2 and the inert gases protect tissues. Tissues deficient in Ca and Mg are more radiosensitive, while those deficient in B are more resistant. (4) Biological Factors. Plants differing very little from each other in genotype vary in radiosensitivity, the one with lower chromosome numbers being more sensitive. Aged seeds are more sensitive than fresh seeds, and the stage of cell division is important. (5) Chemical Mutagens. Nebularine, ethylene oxide, and ethylene imine are given as examples. Some indication is given of the breeding programs in Sweden (cereal crops with varying characteristics), Germany (cereal variants with higher yield and improved characteristics), Britian (self-fertile cherry from the self-sterile type), and U.S.A. (peanut with higher yield). The possibility of using mutations to add a single characteristic to an otherwise well-adapted variety is a small one, exceptions (which are discussed) notwithstanding, because single mutations are almost invariably accompanied by numerous changes in the rest of the genotype. Thus, radioinduced mutation is merely a

method of inducing variability, and the conventional plant breeding techniques of selection and hybridization must follow. However, radiation could be used in other ways, e.g., to overcome barriers to crossing between cultivated species and related wild species, and to separating two genes or two parts of a gene, one of which is useful and the other deleterious. An example is given for the latter use of radiation, that of Sears' work on the crossing of wheat and a wild grass in U.S.A. A critical summary is given of the position of mutation breeding today; enthusiasm for this technique is low in Britian and U.S.A. and high in Germany and Sweden. A large part of research effort on this topic was confined to exploratory work with the result that a total of only 7 new varieties were produced by mutation breeding. The probable course of future research work is discussed. It is concluded that mutation breeding has little justification if the induced changes can be obtained more easily, e.g., by hybridization, with some exceptions: loss mutations, mutations in asexually propagated plants, and mutations in horticultural crops where bizarre forms often have commercial value. (D.L.C.)

20091

EXCLUSIVE IRRADIATION OF THE CIRCULATING BLOOD BY MASSIVE DOSES OF γ RAYS IN THE RAT. Pierre Pellerin, Marie-Louise Remy, Thérèse Becheriot (Institut National d'Hygiène, Châtillon-sous-Bagneux, France). Compt. rend. 250, 4208-9(1960) June 20. (In French)

The exclusive irradiation of the circulating blood was studied on 255 rats using massive doses of γ radiation by an Ir^{192} 1000 c source. Up to 300,000 r the modifications of the formula and the blood count are low. They only become important at 400,000 r, but the results showed that the organism will tolerate well doses up to 700,000 r. (tr-auth)

20092

COMPARISON OF THE BIOLOGICAL EFFICIENCY OF FAST NEUTRONS AND γ RAYS FROM CESIUM-137. Roger R. Ghys (Laval Univ., Quebec). Compt. rend. soc. biol. 154, 242-7(1960). (In French)

A comparative study was made of the effect of γ rays and fast neutrons in the rat in the entire range of lethal doses from a dose less than LD_0 up to a dose higher than LD_{100}. The results showed that the highest dose which does not cause mortality was 150 rads for fast neutrons and 450 rads for γ rays. The smallest dose which killed all the animals was 250 rads for the neutrons and 750 rads for γ rays. The relative biological efficiency of fast neutrons is three for the lethality of "August" rats. It is higher for lesions of the digestive tract and lower for hematopoietic organs. Lethality does not then appear to be a satisfactory criterion to compare the efficiency of neutrons, x rays, and γ rays. The fast neutrons seem to be ideal for the study of the digestive syndrome after irradiation. (J.S.R.)

20093

THE EFFECT OF IRRADIATION ON THE CAPACITY OF THE EYE TO CORNEA INDUCTION. V. V. Popov and A. I. Farberov (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 132, 719-22(1960) May 21. (In Russian)

Transplantation of irradiated (with 1500r) cornea showed considerably faster and more stable induction of the new tissue. An attempt was made to observe the formative influence in irradiated tadpole eyes of transplanted regenerative nonirradiated tissue. The tests were carried out with Rana ribiounda, Rana esculenta, and Bufo bufo in the 2nd to 5th stages of development. The eyeballs were irradiated to various x-ray doses from 50 to 1500r. Transplantation or removal of the tissue followed the second day of exposure. Most experiments involved normal tissue transplantation to the cornea surface. The results of 85 successful transplantations show that tissue grafting in the irradiated eye was successful. However, the transplanted tissue never transformed into new cornea, while complete cornea induction was observed 10 to 12 days after transplantation of cornea in normal eyes. Thus, even small doses (50r) depress the formative ability of cornea in transplanted tissue. Additional tests confirmed the postulation on x-ray induced changes in photoreceptive elements. Studies of photoreceptive, bipolar, and gangliar cells in irradiated and nonirradiated retina indicated radioinduced reduction of about 1.5 fold of the number of these cells. (R.V.J.)

20094

AN INDEPENDENCE OF INTENSITY FOR EMBRYO DOMINANT LETHALS INDUCED BY X-RAYS IN FIRST MEIOTIC METAPHASE EGGS OF HABROBRACON. Leo E. LaChance (Brookhaven National Lab., Upton, N. Y.). Genetics 45, 665-8(1960) June.

Dominant lethals induced in metaphase I eggs of Habrobracon are chromosomal in nature and are dose-rate independent, indicating only one-hit events. (auth)

20095

CENTRIC FRAGMENTS AND POLLEN-PART MUTATION OF INCOMPATIBILITY ALLELES IN PETUNIA. J. L. Brewbaker and A. T. Natarajan (Brookhaven National Lab., Upton, N. Y.). Genetics 45, 699-704(1960) June.

Genetic analyses of five pollen-part incompatibility allele mutants in Petunia indicated that all resulted from the addition of an S gene bearing centric fragment to the normal genome. Fragment-carrying heterogenic pollen grains were uninhibited in all matings as a result of competition interaction. It is suggested that the induction of self-fertility may provide a selective mechanism for the establishment and distribution of supernumerary centric fragments in a species. (auth)

20096

THE EFFECT OF PATERNAL X-RAY EXPOSURE ON THE SECONDARY SEX RATIO IN MICE (F_1 GENERATION). Henry I. Kohn (Univ. of California, San Francisco). Genetics 45, 771-8(1960) June.

CAF_1 male mice, irradiated with 250 kv x rays, were mated during the post-sterile period with unirradiated BALB/cCrgl females. For absorbed doses in the range 0 to 720 rads, the slopes of the following regression lines were not significantly different from zero: males per litter, females per litter, progeny per litter, and sex ratio, both for data at birth and at weaning. (auth)

20097

OVERLAP OF SITE OF ACTION OF X-RAY AND ULTRAVIOLET IRRADIATION IN NOCARDIA CORALLINA. J. B. Clark and R. B. Webb (Univ. of Oklahoma, Norman). J. Bacteriol. 80, 72-6(1960) July.

Successive ultraviolet irradiations of Nocardia corallina resulted first in increased sensitivity associated with a major reduction in the hit multiplicity of the dose-survival curves, and later in increased resistance due to selection for a normally occurring resistant cell in the population. Similar results were reported previously for x irradiation. It was found that cultures subjected to successive ultraviolet irradiations yielded similar response patterns after subsequent exposure to ultraviolet and x rays. The data were interpreted as being indicative of an overlap in the terminal sensitive sites affected by both radiations. The results are consistent with the unpaired defect theory of radiation damage. (auth)

20098
EFFECTS OF PRIOR ALTERATION IN NUCLEIC ACID AND PROTEIN METABOLISM ON SUBSEQUENT MACROMOLECULAR SYNTHESIS BY IRRADIATED BACTERIA. Daniel Billen (Univ. of Texas, Austin and Anderson Hospital and Tumor Inst., Houston, Tex.). J. Bacteriol. 80, 86-95(1960) July.

Synthesis of nucleic acids and protein was partially inhibited after exposure of log phase Escherichia coli strain 15_{T^-} (thymine requiring) and strain B/r to 10,000 r of x rays. Results suggest that the synthesis of a protein constituent(s) is a necessary part of the presynthetic system in DNA replication. The presence of chloramphenicol or deprivation of essential amino acids apparently prevented the formation of this component. Upon removal of the block in protein synthesis there was a resumption in the production of the necessary constituent. X ray exposure prevented the renewed synthesis of the protein needed for DNA replication. (auth)

20099
THE INFLUENCE OF PENETRATING RADIATION ON THE POST-TRAUMATIC REGENERATION OF SKELETAL MUSCLE AND SKIN EPIDERMIS. N. V. Kozlova. Med. Radiol. 5, No. 5, 75(1960) May. (In Russian)

Post-traumatic regeneration of skeleton muscle tissue in white mice exposed to a single whole-body exposure to 250 to 500 r was proceeding according to the norm. Single or chronic exposure to 800, 1500, and 2300 r did not show immediate destruction but depressed post-traumatic regeneration of the muscle tissue. Moreover, cumulative radiation injuries were observed in muscle tissue during chronic exposure. In contrast, a single exposure of skin epidermis to 1500 r showed immediate disturbance of the tissue structure while chronic exposure did not induce morphological changes or show cumulative injuries. The different responses of these tissues must be the result of their physiological regenerative ability. (R.V.J.)

20100
THE STATE OF HISTOHEMATIC BARRIERS IN THE PROGENY OF ANIMALS IRRADIATED WITH GAMMA-RAYS. V. A. Tatsievskaya. Med. Radiol. 5, No. 5, 75-6 (1960) May. (In Russian)

The penetration of histohematic barriers was studied in third generation progenies of irradiated guinea pigs exposed to 450 r at 17 r/min. The distribution of P^{32} in organs of control and tested progenies showed the presence of radioactivity and the following order of its disappearance: kidneys > liver > spleen > suprarenal gland > heart > brain. The radioactivity of the brain was 64 times less than in the kidneys of tested animals and 42 times less than in the kidneys of control animals, indicating high barrier properties of the hemo-encephalic barrier in comparison to other histohematic barriers. (R.V.J.)

20101
THE INFLUENCE OF X-RAYS ON THE CATALASE ACTIVITY IN THE BRAIN OF MICE. K. S. Kosyakov. Med. Radiol. 5, No. 5, 76-7(1960) May. (In Russian)

The catalase activity in the brain of white mice exposed to 400 to 900 r at 30 cm distance was studied. The tabulated data show that 400 r does not affect catalase activity, 500 r activates the ferment but the changes in catalan activity are not clearly established, but 900 r clearly indicates reduced ferment activity, showing that in the pathogenesis of radiation sickness the formation of hydrogen peroxide and catalase activity play a certain part. The depression of catalase activity by the large dose is observed the first day and does not progress the following six days. The tendency of 500 r to increasing catalase could be observed two days after the exposure, followed by a leveling off. (R.V.J.)

20102
CHEMICAL EFFECTS OF IONIZING RADIATIONS ON NUCLEIC ACIDS AND NUCLEOPROTEINS. P. Emmerson, G. Scholes, D. H. Thomson, J. F. Ward, and J. Weiss (Univ. of Durham, Newcastle upon Tyne, Eng.). Nature 187, 319-20(1960) July 23.

The degradation of desoxyribonucleic acid (DNA) by irradiation is discussed in terms of reactions of free radicals with different molecular entities of the macromolecule. The major effect of the irradiation was found to be the attack of the radicals on the purine and pyrimidine bases. The extent of the attack which leads to breakage of internucleotide bonds, leading to the production of phosphomono-ester groups, was determined directly. The hyperchromic effect observed in the action of radiations on nucleic acid solutions was investigated. The chemical nature of the radical reactions with nucleic acid was studied by investigating solutions of the purine and pyrimidine bases and of corresponding nucleosides and nucleotides. Conclusions from the investigation are discussed. (auth)

20103
BIOLOGICAL EFFECTS OF RADIATION. E. M. Binggeli (Bonnard & Gardel, Lausanne, Switzerland). Neue Technik 1, No. 3, 3-5(1959) July. (In French)

The biological effects of radiations are briefly recapitulated. Effects at the molecular level are considered in somewhat greater detail: ionization, excitation of molecules, transmission of energy, breaking up or formation of new chemical bonds. Various effects at the cellular level and on tissues are also dealt with: the formation of toxic metabolites, damage to enzymes, chromosomal aberrations, changes in permeability, effects on the blood, and the formation of tumors. In conclusion, the effects of radiation on the organism in general are discussed. (auth)

20104
STUDIES ON THE METABOLISM AND RADIATION INJURIES OF Cs-137. Kazuhiko Mikota (Osaka City Univ.). Ôsaka Shiritsu Daigaku Igaku Zasshi 8, 1335-62(1959) Sept. (In Japanese)

Results are tabulated from a study of the distribution of cesium-137 in the tissues of rats. Data are also included on the pathological effects of cesium-137 in rats. (C.H.)

20105
EFFECT OF GAMMA RADIATION ON INTERSPECIFIC INCOMPATIBILITY WITHIN THE GENUS BRASSICA. D. Roy Davies and E. T. Wall (Wantage Radiation Lab., Harwell, Berks, Eng.). Z. Vererbungslehre 91, 45-51 (1960). (In English)

An attempt has been made to exploit the destructive properties of ionizing radiations in overcoming the barriers of hybridization that exists between Brassica oleracea, B. campestris, and B. nigra. One series of crosses involving B. oleracea x B. nigra was successful only after irradiating the gametes or stylar tissues prior to crossing. After exposing female gametes, triploid, and after exposing male gametes, diploid progeny were produced. An explanation of these results is sought in terms of a change in the relationship of embryo and maternal or endosperm tissues. (auth)

Radiation Sickness

20106 JPRS-2286(p.5-13)
THE PROBLEM OF THE PATHOGENESIS OF ACUTE RADIATION SICKNESS IN ITS PATHOPHYSIOLOGIC ASPECTS.

P. D. Gorizontov. Translated from Med. Radiol. 4, No. 1, 6-12(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9616.

20107 JPRS-2286(p.59-63)
ACCLIMATIZATION TO HYPOXIA IN COMBINATION WITH THE ADMINISTRATION OF CYSTAMINE AND CYSTEAMINE AS A MEANS OF PREVENTING RADIATION SICKNESS. G. A. Vasil'ev (Vasil'yev). Translated from Med. Radiol. 4, No. 1, 41-4(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9620.

20108 JPRS-2286(p.64-71)
THE EFFECT OF ANTIBIOTIC ON THE INFLAMMATORY PROCESS IN IRRADIATED ANIMALS. V. F. Sosova. Translated from Med. Radiol. 4, No. 1, 45-50(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9621.

20109 JPRS-2286(p.77-85)
THE CONTENT OF LIPIDS IN THE MICROSTRUCTURES OF LIVER CELLS IN RABBITS IN ACUTE RADIATION SICKNESS. V. D. Blokhina. Translated from Med. Radiol. 4, No. 1, 53-9(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9623.

20110 JPRS-2286(p.86-90)
THE ABSENCE OF SUMMATION OF THE PROTECTIVE EFFECTS OF CYSTEINE AND ACTH IN X-IRRADIATION OF RATS. E. (Ye.) M. Kedrova and M. A. Krekhova. Translated from Med. Radiol. 4, No. 1, 60-3(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9624.

20111 JPRS-2286(p.91-5)
THE PROBLEM OF THE PREVENTION OF RADIATION SICKNESS. (THE RESULTS OF TESTS OF CERTAIN PREPARATIONS). V. V. Antipov and I. G. Krasnykh. Translated from Med. Radiol. 4, No. 1, 63-5(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9625.

20112 JPRS-2286(p.126)
THE TREATMENT OF DYSENTERY IN EXPERIMENTAL RADIATION SICKNESS. E. (Ye.) A. Brodskaya, V. P. Emaykina, and A. G. Kostritsa. Translated from Med. Radiol. 4, No. 1, 82(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9627.

20113
THE INFLUENCE OF HOMOGENATES OF LIVER AND BONE MARROW ON THE SURVIVAL OF IRRADIATED RATS. S. A. Rogacheva and N. P. Kudasheva. Med. Radiol. 5, No. 5, 43-6(1960) May. (In Russian)

A study was made of the influence of liver and bone marrow homogenates on the survival of rats subjected to gamma-irradiation in a dose of 1,000 r. It was found that liver homogenates of newborn and female rats increase the 30-day survival of experimental rats on the average by 44%, compared to 18% survival in the control group. Towards the 80th day of the experiment the survival rate in the experimental group comprised 25%, while all animals of the control group perished. Intravenous administration of liver cells of newborn rats proved more effective than the intraperitoneal route. Intravenous introduction of liver cells of newborn rats in the amount of 15×10^6 per recipient exerted an identical effect on the 30- and 80-day survival as the introduction of 13×10^6 per recipient. Administration of rabbit's bone marrow cells in the amount of 3×10^4 caused no increase of the 30-day survival of experimental rats. (auth)

20114
THE TESTING OF INDOLEAMINE COMPOUNDS IN THE PREVENTION OF RADIATION SICKNESS. L. F. Semenov (Inst. of Experimental Pathology and Therapy, Academy of Medical Sciences, USSR). Med. Radiol. 5, No. 5, 47-52 (1960) May. (In Russian)

During the irradiation of mice with lethal doses of x and γ rays (700 and 1,050 r, respectively), tryptophane, benzyltryptamine, tryptamine, serotonin, indole, methylamine, and ethylamine were evaluated as radiation sickness preventatives. A protective effect was obtained with tryptamine (12% survival) and serotonin (23 to 28% survival). A protective action effected by the whole structure of indolethylamine was not revealed in the individual components of its molecule (such as indole, ethylamine, methylamine). The effectiveness of indoleamine compounds intensifies sharply when they are combined with acetylcholine. The efficacy of combinations of tryptamine with acetylcholine (64% of survival) and serotonin with acetylcholine (70% of survival) considerably prevailed over the most active antiradiation protective preparations—betamercaptoethylamine or adrenaline with acethylcholine. A supposition is made that a peripheral neurotropic mechanism lies at the basis of the protective effect of indolethylamides. (auth)

20115
CLINICAL ASSESSMENT OF THE MARKEDNESS OF THE HEMORRHAGIC SYNDROME IN DOGS DURING ACUTE RADIATION SICKNESS. N. V. Butomo (Kirov, Order of Lenin Military Medical Academy). Med. Radiol. 5, No. 5, 63-6(1960) May. (In Russian)

A description is given of a method which enables intravital determination of the degree of hemorrhagic syndrome in dogs with acute radiation sickness. The determination is conducted on the basis of a general evaluation of a number of clinical and laboratory indices, characterizing the principal manifestations of elevated susceptibility to hemorrhage. (auth)

CHEMISTRY

General and Miscellaneous

20116 AERE-R-3377
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE RECOVERY OF ^{231}Pa FROM 60 TONNES OF ETHEREAL SLUDGE. N. Jackson, F. J. G. Rogers, and J. F. Short. June 1960. 23p. BIS.

Declassified version of AERE-R-2987.

The separation of Pa^{231} from a sludge which resulted during processing of U ores by the Ether Purification process is described. After separation of U by nitric acid leaching and TBP extraction, the Pa^{231} was precipitated by aluminum chloride and extracted with di-isobutyl ketone. (C.J.G.)

20117 GAT-P-19
Goodyear Atomic Corp., Portsmouth, Ohio.
RECOVERY OF HYDROGEN FLUORIDE FROM A COOLANT-114–HYDROGEN FLUORIDE MIXTURE. M. L. Geneva and W. R. Pearson. July 19, 1960. 8p. Contract AT(33-2)-1. OTS.

As a result of an equipment failure about 2800 lb. of Coolant-114 were mixed with 84,900 lb. of HF. An analysis of test results and data indicated that the mixture could be safely fed to the fluorine generators in the same manner as normal HF. No adverse effects were noted when the mixture was actually fed to the production generators. (auth)

20118 NAA-SR-4960
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
THE MASS SPECTRA OF DEUTERATED BIPHENYLS: MECHANISMS OF HYDROGEN AND CARBON LOSS PROCESSES. J. G. Burr, J. M. Scarborough, and R. H. Shudde. July 30, 1960. 29p. Contract AT-11-1-GEN-8. OTS.

The monoisotopic mass spectra of biphenyl (I), biphenyl-4, 4′-d_2 (II), biphenyl-3, 3′, 5, 5′-d_4 (III), biphenyl-2, 2′, 6, 6′-d_4 (IV), biphenyl-2, 2′, 4, 4′, 6, 6′-d_6 (V), biphenyl-2, 2′, 3, 3′, 5, 5′, 6, 6′-d_8 (VI), and biphenyl-d_{10} (VII), corrected for the contributions of less deuterated contaminants, are presented. Discussion is presented relative to: (1) the question of chemical selectivity in bond breaking where a possible preference for breaking of the para C-H bonds is shown; (2) the nature and use of the secondary isotope effect in the loss of hydrogen and deuterium in terms of normalized specific probabilities (Γ and π factors); (3) the nature and significance of the primary isotope effect in the loss of hydrogen and deuterium from the molecule-ion; and (4) the factors governing the distribution of peaks within the peak groups corresponding to successive loss of carbon atoms and factors governing the relative size of these peak groups. (auth)

20119 ORNL-2947(p.47-54)
Oak Ridge National Lab., Tenn.
REACTIONS IN AQUEOUS SOLUTIONS. M. J. Kelly, M. D. Silverman, and G. M. Watson. p.47-54 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

Measurements of the rate of peroxide decomposition in 0.034 M uranyl nitrate solution were made to establish whether the decomposition was sufficiently rapid to permit consideration of uranyl nitrate solution as a potential reactor fuel. Tests were made over the temperature range 40 to 100°C with several levels of excess acidity. The effects of known catalysts and corrosion-product materials were established. The results were quite similar to those previously obtained with sulfate and perchlorate systems. The temperature dependence of the decomposition rate was essentially the same as indicated by the calculated activation energy of 25,000 cal/mole. The rate was inversely related to the excess-acid concentration. Iron salts were extremely effective catalysts for the decomposition, and copper salts promoted this activity substantially. Extrapolation of these results to higher temperatures suggests that the rates of peroxide decomposition should prove adequate under anticipated reactor conditions. (auth)

20120 ORNL-2947(p.55-9)
Oak Ridge National Lab., Tenn.
HETEROGENEOUS EQUILIBRIA IN AQUEOUS SYSTEMS. W. L. Marshall, et al. p.55-9 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

The determinations of the compositions of light- and heavy-liquid phases in the system UO_3-SO_3-H_2O and its D_2O counterpart at 300, 325, and 350°C were extended to include light-liquid phases less than 0.1 m in SO_3 and heavy-liquid phases which contained small excesses of UO_3. Further information was obtained on the equilibrium distribution of CuO and/or NiO between the heavy- and light-liquid phases at 325 and 350°C. Solid-liquid equilibria in the system UO_3-CuO-SO_3-H_2O at 325 and 350°C are under investigation. Preliminary values for the simultaneous solubilities of $CuO \cdot 3UO_3$ and $3CuO \cdot SO_3 \cdot 2H_2O$ in sulfate solutions indicate little change from values at 300°C. (auth)

20121 ORNL-2947(p.87-90)
Oak Ridge National Lab., Tenn.
DEVELOPMENT OF GAS-RECOMBINATION CATALYSTS. J. P. McBride and L. E. Morse. p.87-90 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

The sol method of preparing the palladium catalyst for use in the catalytic recombination of hydrogen and oxygen in thoria and thoria-urania slurries gave reproducible activities and the highest specific activities yet obtained. The specific activity appeared also to be independent of the type and concentration of slurry solids. Under excess oxygen, the catalyst performance index (CPI) per millimole of palladium concentration at 280°C and 100 psi hydrogen partial pressure varied from 9 to 22 w/ml. Under excess hydrogen, the CPI was increased by several orders of magnitude. Data obtained in-pile with a slurry of a thorium–8% uranium oxide containing palladium indicated a CPI about four times higher than that obtained out-of-pile in a similar system. Laboratory tests on a slurry sample containing palladium obtained from a loop gas-recombination experiment confirmed qualitatively the drop-off in activity with pumping time observed in the loop run but did not explain the order-of-magnitude-lower specific activities in the loop experiment. (auth)

20122 ORO-287
North Carolina State Coll., Raleigh.
THE SOLUBILITY OF WATER IN BENZENE (thesis). Progress Report No. 6 Revised [on] THE PERFORMANCE OF CONTACTORS FOR LIQUID-LIQUID EXTRACTION. Rafael Alberto Pavia. 1958. 123p. Contract AT(40-1)-1320. OTS.

A report is presented of analytical work for use in interpretation of the pulse column mass-transfer results which constitute the main purpose of the project. The work was done once before, as reported in Progress Report No. 6. However, errors later became apparent, making it necessary to withhold treatment of the mass-transfer results until a more accurate solubility relationship could be obtained. The redetermination of the solubility of water in benzene was organized as a thesis program. The results of the new determination are adequately described in the thesis, which forms the main body of this report. It appears that the present solubility relationship is in fact the accuracy required, and that an interpretation of the mass-transfer results is now possible. (See also ORO-156.) (auth)

20123 TID-3902
Tufts Univ., Medford, Mass.
HYDRIDES OF METALS AND METALLOIDS. A Literature Search. July 1960. 169p. OTS.

A bibliography containing 1966 references is presented on the hydrides of metals and metalloids. References to the chemisorption, diffusion, and solution of hydrogen and the theoretical chemistry, crystal structure, and other properties of hydrides are contained. The references are arranged according to groups of the periodic system, rare-earth metal hydrides, inert gas hydrides, and complex hydrides containing two metallic cations. (C.J.G.)

20124 TID-6149

Purdue Research Foundation, Lafayette, Ind.

CHEMISTRY OF POLYVALENT METAL HALIDES. A. TECHNICAL PROGRESS REPORT [FOR] MARCH 1, 1959 TO FEBRUARY 29, 1960. Herbert C. Brown. 65p. Contract AT(11-1)-170. OTS.

A summary of work in progress is given. Included are data on the gallium bromide catalyzed ethylation of biphenyl, toluene, and benzene in ethylene dichloride at 25°C. In other work, the use of a gas–liquid calorimeter was extended to measurement of the heat of reaction of boron trifluoride with various 2-alkyl-6-t-butyl pyridine, trimethyl amine, phosphine, stibine, and arsine. Investigation of the interaction of boron halides with ethers and amine boranes is reported. Reaction mechanisms and intermediate products are discussed. Design and calibration of an all glass calorimeter for use in studying stabilities of molecular addition compounds of Lewis bases with boron halides are reported. In a study of the kinetics of gallium chloride catalyzed methylation of aromatics in methyl chloride, reaction rates were determined at −36.4°C by gas chromatography. (J.R.D.)

20125 AEC-tr-4133

PRECIPITATION OF ALKALI METALS AS TETRAPHENYLBORON COMPOUNDS. W. Geilmann and W. Gebauhr. Translated by Lydia Venters (Argonne National Lab.) from Z. anal. Chem. 139, 161-81(1953). 26p. JCL.

The analytical behavior of tetraphenylboron sodium in the precipitation of alkali metals was examined by radiochemical methods during the precipitation of K^{42}, Rb^{86}, and Cs^{134}. The solubility of tetraphenylboron compounds of K, Rb, and Cs in water at 20 to 21°C was measured. The effects of the washing liquid, hydrogen ion concentration, temperature of solution, $AlCl_3$, and drying temperature on the precipitation and subsequent determination of the alkali metals are discussed. (C.J.G.)

20126 CEA-tr-A-460

DE L'ÉCHANGE D'IONS AVEC FOCALISATION. VI. APPAREILLAGE POUR LA SÉPARATION EXPÉRIMENTALE D'IONS METALLIQUES (ET AUTRES ELECTROLYTES). (Ion Exchange with Focusing. VI. Apparatus for Experimental Separation of Metallic Ions (and other Electrolytes). Ernst Schumacher and René Flühler. Translated into French from Helv. Chim. Acta 41, 1572-81(1958). 25p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 1981.

20127 CEA-tr-A-657

ECHANGE D'IONS AVEC FOCALISATION. V. SÉPARATION D'IONS MÉTALLIQUES, EN PARTICULIER DE RADIOACTIFS PAR ÉCHANGE AVEC DES PROTONS. (Ion Exchange with Focusing. V. Separation of Radioactive Metallic Ions by Exchange with Protons). [Ernst] Schumacher and K. J. Streiff. Translated into French from Helv. Chim. Acta 41, 824-43(1958). 49p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 11372.

20128

THE NITROGEN ISOTOPIC EQUILIBRIUM BETWEEN AMMONIA AND AMMONIUM ION. Tatsujiro Ishimori (Rikkyo Univ., Tokyo). Bull. Chem. Soc. Japan 33, 516-19(1960) Apr.

In the study of the enrichment of N^{15} with isotopic exchange reactions, the equilibrium of nitrogen isotopes between ammonia and the ammonium ion in aqueous solutions was investigated by the use of a cation exchanger. The equilibrium constants and enthalpy of the reaction were measured. Equilibrium of nitrogen isotopes between ammonia gas and solid ammonium chloride were also measured. The effects of pH, temperature, and concentration of the solution on the fractionation factor between resin and solution were studied. (M.C.G.)

20129

NITROGEN ISOTOPIC EQUILIBRIA BETWEEN AMMONIA AND METAL-AMMINE COMPLEX IONS IN AQUEOUS SOLUTION. Tatsujiro Ishimori (Rikkyo Univ., Tokyo). Bull. Chem. Soc. Japan 33, 520-3(1960) Apr.

The nitrogen isotope effect in the formation of a series of metal-ammine complex ions with ammonia in aqueous solution was investigated. Copper-, zinc-, cadmium-, silver-, and nickel-ammine complex ions were studied using cation exchangers. A theoretical relation was derived between the isotopic equilibrium constant and the first dissociation constant of the complex ion in stable form. (M.C.G.)

20130

THE HYDRATES OF LITHIUM DIBORATE. Roger Bouaziz. Compt. rend. 250, 4170-3(1960) June 20. (In French)

Two hydrates of lithium diborate exist. One, $Li_2B_4O_7 \cdot 4H_2O$, is the only solid in equilibrium with solutions under atmospheric pressure. The crystals in contact with the air lose one mole of water at the temperature of 50°C. The $3H_2O$ hydrate is in equilibrium with solutions under pressure between 150 and 260°C. (tr-auth)

20131

MEDIUM EFFECTS IN THE NUCLEAR MAGNETIC RESONANCE SPECTRA OF LIQUIDS. PART IV. NATURE OF THE EFFECTS. Aksel A. Bothner-By (Mellon Inst., Pittsburgh). J. Mol. Spectroscopy 5, 52-61(1960) July.

Proton magnetic resonance spectra were obtained for several simple organic compounds in the gaseous state and compared with spectra of the neat liquids and of the substances at infinite dilution in a variety of solvents. The change from the gaseous state to the liquid state was accompanied in every case by a down-field shift of the proton resonance signal in excess of that calculated using the classical $2\pi\kappa/3$ correction for the effect of bulk susceptibility. The excess shift, β_i^j, observed for a solute proton, i, in a solvent j, can be calculated empirically using the relation $\beta_i^j = -x_i y_j$, where x_i and y_j are numbers characteristic of the solute and solvent, respectively. The origins of the solvent shift are discussed, and an hypothesis accounting for the observed results is suggested. (auth)

20132

THE PRECIPITATION OF METAL 8-HYDROXYQUINOLATES FROM HOMOGENEOUS SOLUTION. I. PREPARATION OF 8-ACETOXYQUINOLINE. Eugene D. Salesin and Louis Gordon (Case Inst. of Tech., Cleveland). Talanta 4, 75-7(1960). (In English)

A method for the preparation of the ester 8-acetoxyquinoline, an excellent source reagent for the generation of 8-hydroxyquinoline, was developed. It was found that the use of 8-acetoxyquinoline in the precipitation of metal 8-hydroxyquinolates resulted in the formation of large well developed and readily filterable precipitates as compared to conventional precipitation. In the method chosen, acetic anhydride was heated with 8-hydroxyquinoline and then the 8-acetoxyquinoline was distilled. After solidification, the crystals were purified by recrystallization from a mixture of isopropyl ether and n-heptane. (M.C.G.)

20133

MECHANISM OF THE HYDROGEN–DEUTERIUM EXCHANGE ON NICKEL. G.-M. Schwab and E. Killmann (Universität, Munich). Z. physik. Chem. (Frankfurt) (N.S.) 24, 119-29(1960) Apr. (In German)

Measurements on the kinetics of the hydrogen–deuterium exchange on nickel foils were made between 100 and 165°C. The apparent activation energy is 7.5 kcal/mole. The kinetics is represented by a logarithmic decrease of the distance from equilibrium. The initial velocity depends on the partial pressure of the hydrogen and deuterium in an unsymmetrical manner. The result is best represented by a bimolecular exchange between adsorbed molecules (atomic pairs) in agreement with previous results. (tr-auth)

20134

CARBONATE COMPOUNDS OF CERIUM(IV). V. A. Golovnya and L. A. Pospelova (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim. 5, 1036-43(1960) May. (In Russian)

Several attempts to synthesize $Ce(CO_3)_2$ were unsuccessful. The solubility of Ce(IV) salts in alkaline carbonate solution indicates the existence of complex cerium compounds. A number of pentacarbonate cerates of the type $Me_8[Ce(CO_3)_5H_2O] \cdot nH_2O$ were prepared where Me represents Na, K, the guanadine radical or $\frac{1}{3}$ $Co(NH_3)_6^{3+}$. Thermographic analysis showed that the last molecule of water was firmly bound to the cerate compound and was released only on decomposition of the compound. In a similar fashion it was shown by thermographic analyses that guanadine tetracarbonate cerate $(CN_3H_6)_4[Ce(CO_3)_4(H_2O)_2] \cdot 4H_2O$ and ammonium guanadine tetracarbonate cerate $(NH_4)_2(CN_3H_6)_2$ $[Ce(CO_3)_4(H_2O)_2]$ gave up the last two molecules of water only on decomposition of the compound. The ammonium cobaltihexammine hexacarbonate cerate $(NH_4)_2[Co(NH_3)_6]_2$ $[Ce(CO_3)_6] \cdot 4H_2O$ was rather unstable and decomposed at 110°C to $[Co(NH_3)_6]_2$ $[Ce(CO_3)_5]$ with a loss of $(NH_4)_2CO_3$ and H_2O. Potentiometric titration of the pentacarbonate compound $(CN_3H_6)_6$ $[Ce(CO_3)_5H_2O] \cdot H_2O$ with 0.1 N HCl showed that at a pH of approximately four, three moles of carbonate were titrated to CO_2 while two moles were not titrated. On titrating the tetracarbonate compound $(NH_4)_2$ $(CN_3H_6)_2$ $[Ce(PO_3)_4(H_2O)_2]$, only two moles of carbonate were titrated to CO_2 at pH approximately four, while two moles remained untitrated. This evidence indicates that the carbonate groups in the various complexes are not equivalent. It is proposed that the coordination number of Ce(IV) in these carbonate complexes is constant at a value of eight. (TTT)

20135

SOLVATES OF ZIRCONIUM AND HAFNIUM NITRATES WITH TRIBUTYLPHOSPHATE (TBP). G. F. Egorov, V. V. Fomin, Yu. G. Frolov, and G. A. Yagodin. Zhur. Neorg. Khim. 5, 1044-50(1960) May. (In Russian)

On varying the concentration of TBP in xylene from 1.0 to 3.68 M and the nitric acid concentration from 3.6 to 11.1 M, it was shown that the experimental values of the distribution coefficient (K_D) of HNO_3 agree with values calculated from the stability constant for $TBP \cdot HNO_3$ (0.22) and for $TBP \cdot 2\ HNO_3$ (0.00044). It can be shown that the distribution coefficient of a metal at a constant acid strength is proportional to the concentration of free TBP raised to the x power, where x is the number of solvate TBP molecules per molecule of metal. The concentration of free TBP at any HNO_3 concentration can be calculated from the known stability constants of $TBP \cdot HNO_3$ and $TBP \cdot 2\ HNO_3$. The slope of a line obtained on plotting the log of the distribution coefficient versus the log of the free TBP gives the number of solvate TBP molecules in the Zr and Hf complexes. Three series of experiments were run at equilibrium concentrations of HNO_3 in the aqueous phase of 3, 4, and 5 mol/liter with a variable concentration of free TBP in the organic phase. The complex was found to be $Zr(NO_3)_4 \cdot$ TBP at low concentrations of TBP, and $Zr(NO_3)_4 \cdot 2$ TBP at high concentrations of TBP. At constant TBP and nitrate concentrations, it was found that the distribution coefficient of Zr and Hf decreased with decreasing acidity. (TTT)

20136

ZIRCONIUM AND HAFNIUM COMPLEXES WITH VARIOUS HYDROXY ACIDS. D. I. Ryabchikov, A. N. Ermakov, V. K. Belyaeva, and I. N. Marov. Zhur. Neorg. Khim. 5, 1051-67 (1960) May. (In Russian)

Zr^{95} and Hf^{181} tracers were used to determine the distribution coefficients of Zr and Hf (5×10^{-6} mol/l) from 0.25, 0.5, 1.0, and 2.0 N $HClO_4$ with the sulfonate cation exchanger KU-2 in the presence of a carboxylic acid containing a hydroxyl group such as citric, tartaric, trihydroxyglutaric, malic, and lactic acids. Even in very acid media, stable complexes of Zr and Hf are formed. The Zr complex in all cases is stronger than the Hf complex. The separation coefficient $\alpha = K_{Hf}/K_{Zr}$ was equal to 2.0 for trihydroxyglutaric acid. At low concentrations of acid ($HClO_4 = 0.125$ N) and of the organic complexing agent malic acid (2.56×10^{-2} mol/l) $\alpha = 7$, but α rapidly falls to 1.8 on increasing the concentration of malic acid to 0.16 mol/l at 0.125 N $HClO_4$. In 0.5 N $HClO_4$ α remains constant at 5.5 even at higher concentrations of malic acid. The value of α is constant at approximately three for tartaric acid. The greatest difference in behavior of Zr and Hf was noted with citric acid; in 1.0 N $HClO_4$ α = 5 and in 2.0 N $HClO_4$ $\alpha = 4$. A sharp separation of Zr from Hf was demonstrated by eluting with 1.0 N $HClO_4$ and 0.0256 M citric acid at a rate of 0.8 ml/min cm^2 on a sulfonate cation exchange column 10 mm in diameter and 250 mm long at a loading of 15 mg each of Zr and Hf. All the Zr was eluted in the first 200 ml of solution. The composition and formation constants of the Zr and Hf complexes with tartaric, malic, trihydroxyglutaric, citric, and lactic acids were determined. The strength of the Zr and Hf complexes decreases in the following order: oxalate > mesoxalic > trihydroxyglutaric > citric > lactic > tartaric > malic. (TTT)

20137

POLAROGRAPHIC STUDY OF THE REDUCTION AND OXIDATION OF RUTHENIUM CHLORIDE COMPLEXES ON A PLATINUM ELECTRODE. N. K. Pshenitsyn and N. A. Ezerskaya. Zhur. Neorg. Khim. 5, 1068-73(1960) May. (In Russian)

The purpose of this study was to find a quantitative method of determining ruthenium by polarography. $K_2[RuOHCl_5]$ is stable in 2 N HCl and 1 N NaCl for days. Polarograms are reproducible. The diffusion current is proportional to the concentration of ruthenium from 5×10^{-5} to 5×10^{-3} mol/l of ruthenium (5 to 500 γ) with an accuracy of 1.5 to 2.0%. The half-wave potential $E_{1/2}$ varies from 0.415 to 0.435 V (compared to a saturated calomel electrode). The reduction of "brown salt" $K_2[RuOHCl_5]$ is irreversible and goes slowly to the "red salt" $K_2[RuH_2OCl_5]$ and not to any intermediate compound. Comparison of the diffusion current obtained for the reduction of $K_2[RuOHCl_5]$ with that obtained for the reduction of K_2IrCl_6 showed that the actual current is only one-half of the theoretical current. This evidence points to the presence of the binuclear complex $[Ru_2OCl_{10}]^{4-}$ in solution. The Ru(III) compound $K_2[RuH_2OCl_5]$ can be reversibly oxidized and reduced on a

platinum electrode in 1.0 N NaCl + 2 N HCl. The oxidation of Ru(III) takes place at a higher positive potential of 0.8 to 1.0 v and, as spectrophotometric evidence shows, results in the form of a compound different from "brown salt." The adsorption spectra of this compound show maxima at 310 and 420 mμ. This compound has a reduction wave of $E_{½} \sim 0.7$ v. The diffusion current is greater than that obtained for the same amount of ruthenium taken as the "brown salt." The oxidation wave of the "red salt" can not be used for analytical purposes because of interference from chloride ion. (TTT)

Analytical Procedures

20138 AERE-EL/M-108

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

DETECTION OF BERYLLIUM BY THE γ-N METHOD. P. Iredale. May 1960. 14p. BIS.

Experiments were performed to determine the sensitivity with which Be can be detected by the γ-n reaction. A 1.5 curie source of Sb^{124}, in the form of a cylinder with an axial hole, was used to irradiate samples of small physical size, ~0.5 cc or less. Neutrons were detected by 12 BF_3 counters placed in a moderator. The optimum arrangement of counters and source and the choice of BF_3 counters were investigated. With the apparatus measurements could be made as the difference between two counts of one hour's duration, one with and one without the sample. Under these conditions 4 μg of Be give a count rate which is equal to three times the standard deviation of this difference measurement. (auth)

20139 CEA-1249

France. Commissariat a l'Énergie Atomique, Centre d'Études Nucléaires, Saclay.

UTILISATION DE LA SPECTROGRAPHIE GAMMA DANS L'ANALYSE PAR ACTIVATION. (Use of Gamma Spectrography in Activation Analysis). P. Lévêque. 1959. 32p.

A brief review is given of the principles of activation analysis: calculation of activities, decay curves, β absorption curves, examples of application. Principle and description of the γ spectrograph is given with descriptions of practical utilization of the γ spectrograph: analysis by activation, analysis by β−x fluorescence. Sensitivity limit of the method and precision of the measurements are discussed. Possible improvement of the method by γ spectrography with elimination of the Compton effect is also discussed. (auth)

20140 KAPL-M-OJA-2

Knolls Atomic Power Lab., Schenectady, N. Y.

THE DETERMINATION OF LEAD AND TELLURIUM IN LEAD−TELLURIUM ALLOYS. O. J. Articolo. June 15, 1960. 11p. Contract W-31-109-eng-52. OTS.

The Pb is determined gravimetrically by fuming a solution of the alloy with H_2SO_4 and weighing the Pb as $PbSO_4$. The Te is determined volumetrically in the filtrate. The Te(IV) ions are oxidized to the hexavalent state by an excess of standard potassium dichromate, and the excess dichromate is titrated with standard ferrous ammonium sulfate. (auth)

20141 ORNL-2947(p.127-9)

Oak Ridge National Lab., Tenn.

ANALYTICAL CHEMISTRY. O. Menis, H. P. House, et al. p.127-9 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

Flame-photometric methods were devised for the determination of calcium and also rare-earth elements in ThO_2. In the determination of calcium, an additive to the ThO_2 for the purpose of increasing its density, an $HClO_4$ solution of the sample is aspirated into the flame, and standard solutions of calcium containing thorium in a concentration approximately that of the sample are used for calibration purposes. In the application of flame photometry for the estimation of rare-earth elements in ThO_2, the sample is dissolved in a nitrate medium. The thorium is then removed by an extraction procedure to prevent its interference. After destruction of ammonium acetate in the raffinate, the rare-earth elements are extracted and subsequently determined flame-photometrically in the organic phase. A direct coulometric titration method was applied to the estimation of U(IV) in slurries of $ThO_2 \cdot UO_x$. For samples containing 1 to 10 mg of U(IV) the coefficient of variation was 1%. Conductometric titrimetry was used to determine free H_2SO_4 in radioactive uranyl sulfate fuel solutions. For 0.05 M H_2SO_4 solutions, the relative standard deviation was less than 1%. (auth)

20142 PGR-115(W)

United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England.

THE SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN POTASSIUM BROMIDE AND BROMATE AND SODIUM NITRITE BY DIRECT EXCITATION. May 1960. 8p.

The sample is diluted with graphite powder and arced in a graphite cup. Spectra are compared visually with those on a standard plate. (auth)

20143 PGR-139(W)

United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England.

ANALYTICAL METHOD FOR THE POLAROGRAPHIC DETERMINATION OF COPPER IN URANIUM SOLUTIONS. July 1960. 6p. BIS.

Copper is determined in U solutions by an a-c polarographic method using ammoniacal base solution containing $(NH_4)_2CO_3$ to complex the U. (auth)

20144 CEA-tr-R-833

ANALYSE SPECTROGRAPHIQUE PAR LA MÉTHODE D'ÉVAPORATION. V. ANALYSE DU PLUTONIUM PAR LA MÉTHODE D'ÉVAPORATION SOUS VIDE. (Spectrographic Analysis by Evaporation. V. Analysis of Plutonium by Evaporation in Vacuum.). A. N. Zaĭdel, N. I. Kaliteevskiĭ (N. T. Kaliteevsky), L. V. Lipis, and V. M. Tarakanov. Translated into French from Optika i Spektroskopiya 3, 16-20(1957). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 9711.

20145

DETERMINATION OF FISSION PRODUCT IODINE. CATION EXCHANGE PURIFICATION AND HETEROGENEOUS ISOTOPIC EXCHANGE. William J. Maeck and James E. Rein (Phillips Petroleum Co., Idaho Falls, Idaho). Anal. Chem. 32, 1079-80(1960) Aug.

This method for the determination of radioiodine in fission product mixtures is based on separation of other activities by cation exchange, followed by heterogeneous isotopic exchange of iodide. Overall recovery is 97.1% with a coefficient of variation of 3.1% when standard iodine-131 is used. Precision based on replicate deter-

minations of iodine-131 in 14-day-old fission product samples is 3.6% coefficient of variation. A major advantage of the method is that no yield determination is required. (auth)

20146

APPLICATION OF CONVERSION X-RAY SPECTRA TO ISOTOPIC ANALYSIS. RESOLUTION OF CESIUM-134 [AND] CESIUM-137 MIXTURES. M. T. Kinsley, J. B. Cumming, and H. L. Finston (Brookhaven National Lab., Upton, N. Y.). Anal. Chem. 32, 1081-3(1960) Aug.

Cesium-134 and cesium-137 activities in a mixture of the isotopes are determined by analyzing both the gamma spectrum and x-ray spectrum of the mixture. The gamma spectrum exhibits photopeaks at 800 and 605 kev. Assay for cesium-134 is obtained from the area under the 800-kev photopeak. The x-ray yield due to the internal conversion electrons is calculated to be an order of magnitude greater for cesium-137 than for cesium-134. The spectrum of the 32-kev barium x-rays resulting from the internal conversions is obtained and utilized for the assay of cesium-137. The accuracy of the cesium-134 determinations is within 1%. The cesium-137 content of mixtures having cesium-134 to cesium-137 activity ratios as high as 19.2 to 1 is determined with an accuracy greater than 7%. (auth)

20147

SPECTROPHOTOMETRIC DETERMINATION OF SMALL AMOUNTS OF URANIUM WITH 8-QUINOLINOL. Kenji Motojima, Hiroyuki Yoshida, and Kimie Izawa (Japan Atomic Energy Research Inst., Tokyo). Anal. Chem. 32, 1083-5(1960) Aug.

A simple method using 8-quinolinol was developed for determining uranium spectrophotometrically. Uranium (VI) 8-quinolinolate is quantitatively extracted with chloroform from slightly alkaline solution and the absorbance is measured at 380 mμ. Beer's law is followed over the range of 2 to 40 γ of uranium per ml. of chloroform, and many metallic ions present in the form of impurities (100 γ each) do not interfere. In the presence of EDTA, 5 mg of thorium or rare earth elements do not interfere. (auth)

20148

DETERMINATION OF THORIUM BY MONOCHROMATIC X-RAY ABSORPTION. J. H. Stewart, Jr. (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Anal. Chem. 32, 1090-2(1960) Aug.

A monochromatic x-ray absorption analysis for thorium in many sample types is independent of the matrix effects usually associated with x-ray emission analysis. Thorium may be directly determined in liquid samples containing percentage quantities of impurity elements in concentration ranges of 100 to 15,000 μg of thorium per ml. Solid samples may be analyzed by this technique after dissolution. Lead and uranium in concentrations of 5000 μg per ml do not interfere; however, bismuth and strontium do and a tri-n-butyl phosphate liquid-liquid extraction of the thorium to eliminate these interferences is described. The limit of error for a single analysis at the 95% confidence level is ±2.8% for 2000 μg of thorium per ml of solution. The intensity of the transmitted x-ray beam taken at wave lengths on each side of the Th_{LIII} absorption edge is used to measure the thorium concentration. Duplicate thorium determinations on liquid samples may be completed within 25 minutes. (auth)

20149

ANALYSIS OF SLAG FROM THE MANUFACTURE OF URANIUM METAL. DETERMINATION OF MAGNESIUM OXIDE AND MAGNESIUM METAL. John McKend (Eldorado Mining and Refining, Ltd., Ottawa). Anal. Chem. 32, 1193-6(1960) Aug.

A complexometric method for the quantitative determination of magnesium metal and magnesium oxide in magnesium fluoride slag is described. The magnesium metal and magnesium oxide are leached from the slag with an ammoniacal solution (pH 10) of (ethylenedinitrilo)tetraacetic acid (EDTA) and the total magnesium in the extract is determined by a complexometric procedure. The magnesium metal is determined in a similar manner after the magnesium oxide has been extracted by leaching the slag with dilute acetic acid in the presence of potassium dichromate. The magnesium oxide is determined by difference. Provision is made for the removal of ferric, aluminum, uranium, and fluoride ions which interfere in the determination. Precision data from the analysis of samples are presented. (auth)

20150

DETERMINATION BY X-RAY FLUORESCENCE OF THE CERRIC EARTHS. Charles Legrand, Jean Loriers, Claudine Bouriannes, and Jacqueline Poulain (Comitato Nazionale per le Ricerche Nucleari, Rome). Compt. rend. 250, 4364-6(1960) June 27. (In French)

The analytical method of x-ray fluorescence appears to be well suited to the control of the separation of rare earths by ion exchange. For the ceric earths lanthanum, praseodymium, and neodymium, the determinations can be made on their solutions. With ternary mixtures, linear calibration curves are obtained. (tr-auth)

20151

SIMULTANEOUS DETERMINATION OF BARIUM AND STRONTIUM IN SILICATE ROCKS BY THE ADDITION METHOD IN EMISSION SPECTROMETRY IN AN ELECTRIC ARC. Victor Gabis (Faculté des Sciences, Paris). Compt. rend. 251, 232-4(1960) July 11. (In French)

In order to avoid the causes of systematic error inherent in other spectrographic methods, the technique of successive additions was utilized for the determination of barium and strontium in silicate rocks. It was shown that the chemical state of the sample analyzed has no effect on the results. (tr-auth)

20152

THE QUERCETIN–HYDROGEN PEROXIDE METHOD FOR THE COLORIMETRIC DETERMINATION OF HAFNIUM IN ZIRCONIUM. E. Cerrai and C. Testa (Centro Informazioni Studi Esperienze, Milan). Energia nucleare (Milan) 7, 477-87(1960) July. (In English)

A new spectrophotometric method was developed for the determination of hafnium content in zirconium. The method is based on the effect of hydrogen peroxide on zirconium-Quercetin system. The influence of the various experimental conditions was studied and a procedure established for Hf determination in the following concentration fields: zero to 100 mole % Hf in Zr; zero to 20 and zero to 5. By a suitable operating procedure, 0.1 Hf in Zr can be easily determined. A complete method for the isolation of Zr + Hf from many interfering substances and the subsequent Hf determination was also described. (auth)

20153

SPECTRAL ANALYSIS OF ALUMINUM AND NICKEL ALLOYS. A. S. Dem'yanchuk and O. P. Ryabushko (Paton Inst. of Electric Welding, Kiev). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 4, 111-14(1960) Apr. (In Russian)

The results are given of a method of analyzing aluminum and nickel alloys. A high frequency discharge is used as a

light source. A modified plan of a standard generator IG-2 is described which can be used to obtain a stable low-power discharge. (auth)

20154

SEMIMICRO ANALYSIS OF ALLOYS CONTAINING ZIRCONIUM. Leo Lehrman, Martin Dorenbush, and Natalie Meisler (The City Coll., New York). J. Chem. Educ. 37, 407-8(1960) Aug.

A semimicro method for the qualitative analysis of zirconium was developed. In the analysis of metal ions zirconium appeared in Group III as a hydroxide with iron and titanium. The three hydroxides were dissolved in dilute HCl and the zirconium separated by precipitation with arsenic acid. Then the zirconium arsenate was dissolved in concentrated HCl and alizarin red S added. A red color proved the presence of zirconium. The amount present was estimated by determining the number of drops of a standard sodium fluoride solution necessary to change the red zirconium alizarinate to yellow. (M.C.G.)

20155

COMPLEXOMETRIC TITRATION OF THORIUM USING SOME AZO DYES FROM CHROMOTROPIC ACID. Sachindra Kumar Datta (Victoria Government Coll., Cooch Behar, India). J. Sci. Ind. Research (India) 19B, 168-70 (1960) May. (In English)

A procedure was developed for the direct and rapid determination of thorium with ethylenediamine tetraacetic acid using three azo dyes: 2-(5-sulfonaphthylazo)-1,8-dihydroxynaphthalene-3,6-disulfonic acid (SNADNS-5), 2-(6-sulfonaphthylazo)-1,8-dihydroxynaphthalene-3,6-disulfonic acid (SNADNS-6) and 2-(4-carboxy-3-hydroxyphenylazo)-1,8-dihydroxynaphthalene-3,6-disulfonic acid (CHPADNS). The dyes formed colored chelates with thorium, in slightly acid medium, which were decomposed by the addition of EDTA. The thorium complex of EDTA was more stable than those of the dyes and showed marked color change at the end-point. The interference of various metallic ions, particularly iron, in the estimation of thorium was also investigated. A method was developed for the estimation of thorium in the presence of iron using CHPADNS as the indicator. (auth)

20156

CRITICAL STUDY OF THE DETERMINATION OF HYDROGEN IN STEEL. J. Calmettes, Ch. Dubois, and P. Bastien. Mém. sci. rev. mét. 56 641-56(1959) Dec. (In French)

Within the framework of the International Commission for the Study and Rationalization of methods for the determination of gases in steel, investigations are reported which were carried out either at the instigation of the Commission or on the initiative of the authors themselves, along with the opinions which they hold on the conditions which must be rigorously observed in the taking of a liquid steel sample for the estimation of hydrogen. After describing the extraction apparatus formerly used in the S.F.A.C. laboratory, a new apparatus equipped with a palladium filter for separating the hydrogen from the accompanying impurities within the extraction time during the degassing of a steel specimen held in vacuo at constant temperature is described. The release of hydrogen from a specimen held in vacuo at 600°C follows the exponential law. The transport of a sample taken by pneumatic means and the application of this law makes it possible to determine a probable content which is very satisfactory for everyday production control within a period of less than 30 minutes from the taking of the sample to the transmission of the results by teleprinter. (auth)

20157

DETERMINATION OF LOW CARBON CONTENT IN URANIUM. L. Champeix, H. Chevilliard, and J. Ponty (Centre d'Études Nucléaires, Saclay, France). Mém. sci. rev. mét. 56, 657-62(1959) Dec. (In French)

The method of carbon determination previously used for low carbon steels was applied to uranium. Carbon contents down to a few tens ppm, and probably to a few ppm, can be determined with satisfactory precision, sensitivity, and accuracy. (auth)

20158

DETERMINATION OF OXYGEN IN ZIRCONIUM AND ... CONIUM ALLOYS BY EMISSION SPECTROGRAPHY IN AN ARGON ATMOSPHERE. J. Artaud and C. Berthelot (Centre d'Études Nucléaires, Saclay, France). Mém. sci. rev. mét. 57, 338-44(1960) May. (In French)

The discharge of an arc in an argon atmosphere permits the estimation of gases in metals, particularly oxygen in zirconium. Extraction by reduction melting in a platinum bath and excitation of the oxygen take place in the same surroundings. Specimens of zirconium and of zirconium alloys containing 250 to 2,750 ppm of oxygen were analyzed by this method. The size of the ratio O-7 771.928 A/Ar-7 891.075 A recorded by the Jarrell-Ash grating spectrometer (15,000 lines per inch) gives a curve which remains linear up to an oxygen value of 2×10^{-5} g. (auth)

20159

PHOTOMETRIC DETERMINATION OF YTTRIUM WITH STILBAZO. L. S. Serdyuk and G. P. Fedorova (Dnepropetrovsk State Univ., USSR). Zhur. Anal. Khim. 15, 287-90(1960) May-June. (In Russian)

The reaction of yttrium with stilbazo was investigated at pH 7.0. The composition of the complex formed during the reaction was established by the method of isomolar series. The effect of some foreign ions and masking substances on this reaction was studied. The possibility is shown of using this reaction for the colorimetric determination of yttrium in the absence and in the presence of lanthanum. (auth)

20160

INVESTIGATIONS IN THE ANALYTICAL CHEMISTRY OF THALLIUM. COMMUNICATION 5. DIANTIPYRILPROPYLMETHANE AS A REAGENT FOR THE QUANTITATIVE DETERMINATION OF THALLIUM. A. I. Busev and V. G. Tiptsova (Moscow State Univ.). Zhur. Anal. Khim. 15, 291-4(1960) May-June. (In Russian)

Diantipyrilpropylmethane is suggested for the gravimetric determination of thallium by precipitating and weighing as $C_{26}H_{30}O_2N_4 \cdot HTlBr_4$ and $C_{26}H_{30}O_2N_4 \cdot HTlCl_4$. It was established that the precipitation of the chloride complexes of trivalent thallium can be carried out in the presence of Zn, Cu, Cd, Bi, Zn, PO_4^{3-}, and AsO_4^{3-}. (auth)

20161

PHOTOMETRIC DETERMINATION OF SMALL AMOUNTS OF THORIUM WITH ARSENAZO. V. I. Kuznetsov and I. V. Nikol'skaya. Zhur. Anal. Khim. 15, 299-305(1960) May-June. (In Russian)

A method was developed for the determination of 1×10^{-4} to 1×10^{-2} % thorium in 0.5 to 1.0 g samples. A solution of rare earths nitrates is added to the sample which is then decomposed with a mixture HF + HNO_3, the dry residue is dissolved in 6 M HCl, diluted with water to 75 ml, and thorium is co-precipitated with rare earth oxalates by adding oxalic acid. The procedure is repeated twice. The oxalates are decomposed by the mixture of $HClO_4$, HNO_3, and HCl, arsenazo is added and the photometric measurement is carried out at a pH of 1.9 with the use of a spectrophotometer at 580 mμ or visually by the

method of standard series. It is possible to determine 1 to 175 γ of thorium without using an aliquot. (auth)

20162

A SENSITIVE AND SELECTIVE PHOTOMETRIC METHOD FOR THE DETERMINATION OF TITANIUM BY MEANS OF DISULPHOPHENYLFLUORONE. V. A. Nazarenko and E. A. Biryuk (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian, SSR). Zhur. Anal. Khim. 15, 306-10(1960) May-June. (In Russian)

A study was made of trihydroxyfluorone derivatives substituted at C_9 as a reagent for titanium. It was shown that 9-(2',4'-disulphophenyl)-2,3,7-trihydroxy-6-fluorone (disulphophenylfluorone) is the most suitable for the photometric determination of this element. The ratio between titanium and disulphophenylfluorone in the complex is 1:2. The maximum extinction of titanium disulphophenylfluoronate is at 570 mμ, the molar extinction coefficient is 108000 at the optimum pH 6. The solutions of the complex follow Beer's law. The minimum amount of titanium which can be determined is 0.01 μg/ml. The method was applied to the determination of traces of titanium in germanium and silicon. The sensitivity of the determinations was down to 5×10^{-6} %. (auth)

20163

PHOTOMETRIC DETERMINATION OF MICROQUANTITIES OF URANIUM WITH ARSENAZO III. V. F. Luk'yanov, S. B. Savvin, and I. V. Nikol'skaya. Zhur. Anal. Khim. 15, 311-14(1960) May-June. (In Russian)

A rapid method for the determination of microquantities of uranium was developed. The method is based on the formation of colored compounds of tetravalent uranium with arsenazo III in 4 N HCl. The reduction of uranium is carried out by means of granulated zinc in the presence of ascorbic acid. The sensitivity of the method is 0.04 γ/ml of uranium. The limiting concentration of uranium which can be determined in the test material is 0.002%. The most of accompanying elements do not interfere (thorium is an exception). Zirconium can be selectively masked by means of oxalic acid. (auth)

20164

SPECTROGRAPHIC DETERMINATION OF URANIUM BY THE METHOD OF ISOTOPE ADDITIONS. N. P. Ivanov. Zhur. Anal. Khim. 15, 315-20(1960) May-June. (In Russian)

Precision modifications are described of the optical spectral method of isotope additions for the determination of uranium in ores and by-products. It was shown that by carrying out the analysis by the equal blackening method there is no necessity to take into consideration the background, the properties of photographic emulsion, and the effects of the re-absorption. The latter gives the possibility to determine uranium in ores with the accuracy of ±1 to 2% irrespective of their uranium mineralization and the composition of the enclosing rocks. A method of two isotopes is discussed in detail. It was shown that by using this method it is possible to analyze samples containing large quantities of calcium, tungsten, and certain elements which have multiline spectra (thorium, rare earths a. o.). The method is rapid and satisfactorily accurate. (auth)

20165

DETERMINATION OF SOME MICROADMIXTURES IN SELENIUM OF HIGH PURITY. COMMUNICATION III. O. E. Zvyagintsev and V. I. Shamaev (Mendeleev Inst. of Chemistry and Tech., Moscow). Zhur. Anal. Khim. 15, 325-8(1960) May-June. (In Russian)

A radioactivation method for determining microquantities of silver, mercury, cobalt, chromium, calcium, and indium in selenium was developed. The accuracy of the determination of individual elements is 10 to 30%. (auth)

20166

RADIOACTIVATION ANALYSIS OF SEMI-CONDUCTIVE SILICON BY MEANS OF A MULTICHANNEL γ-SPECTROMETER. I. E. Makasheva, I. A. Maslov, and A. P. Obukhov (Leningrad Inst. of Physics and Tech.). Zhur. Anal. Khim. 15, 329-33(1960) May-June. (In Russian)

A method for the radioactivation analysis of silicon after the chemical treatment of the sample was developed. The use of a γ spectrometer for measuring the activity of the impurities makes unnecessary the radiochemical purification of the precipitates separated and permits the identification of most of the impurities by a single measurement of their activity. (auth)

20167

ANALYSIS OF CERTAIN ZIRCONIUM-BASE ALLOYS. S. V. Elinson, L. I. Pobedina, and N. A. Mirzoyan. Zhur. Anal. Khim. 15, 334-8(1960) May-June. (In Russian)

Extraction of zirconium from 1 N sulphuric acid with a chloroform solution of nitrosophenylhydroxylamine acid was suggested. It was shown that by two-fold extraction the quantitative extraction of zirconium into chloroform may be achieved, whereas aluminium, beryllium, magnesium, and other elements remain totally in aqueous solution. The method can be applied for the determination of aluminium, beryllium, uranium, magnesium, and zinc in zirconium and in zirconium-base alloys. (auth)

20168

SPECTROGRAPHIC METHOD FOR THE DETERMINATION OF LITHIUM AND BERYLLIUM IN PROSPECTING FOR THEIR DEPOSITS. O. F. Chesnokov (Siberian Geophysical Trust, Krasnoyarsk, USSR). Zhur. Anal. Khim. 15, 362-3 (1960) May-June. (In Russian)

The spectral method of determining lithium and beryllium in rock under field conditions proved satisfactory. Lithium was determined using lines 3232.61 from 0.01 up to 0.1%; Li 2741.31 from 0.1 to 1%; beryllium lines 2348.61 from 0.0005 up to 0.01%; Be 3131.07 from 0.03 to 0.5%. (R.V.J.)

20169

CHROMATOGRAPHIC SEPARATION OF HAFNIUM AND ZIRCONIUM AND THE DETERMINATION OF HAFNIUM BY THE ISOTOPE-DILUTION METHOD. G. M. Kolosova, Yüan-p'an Ch'eng, and M. M. Senyavin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Anal. Khim. 15, 364-6(1960) May-June. (In Russian)

The proposed method for the determination of hafnium in the presence of zirconium involves separation on cation exchange resin and the use of the isotope-dilution method. The results for various mixtures are in good agreement with the data from x-ray spectral analysis. The mean experimental error is 5 to 7% (relative). (auth)

20170

A SIMPLE METHOD FOR THE DETERMINATION OF RADIOACTIVITY OF COMPOUNDS LABELED WITH C^{14}. V. I. Maimind, M. I. Lerman, and L. A. Neiman (Inst. of Biological and Medical Chemistry, Moscow). Zhur. Anal. Khim. 15, 371-3(1960) May-June. (In Russian)

A simple and rapid method was suggested for preparing samples for measuring the radioactivity of non-volatile organic compounds containing C^{14}. (auth)

20171

URANYL THIOSULFATE. A. E. Klygin and N. S. Kolyada. Zhur. Neorg. Khim. 5, 1170-1(1960) May. (In Russian)

The luteo cobalt chloride $[Co(NH_3)_6]Cl_3$ was used to precipitate the insoluble anionic thiosulfate complexes of Cd, Cu, and Pb. Excess thiosulfate is determined iodimetrically. This reaction was investigated as a method of determining uranium in solution. It was found that the solubility of uranyl thiosulfate decreased with increasing concentration of sodium thiosulfate. This behavior indicated that complexes of the type $UO_2(S_2O_3)_2^{2-}$ and $UO_2(S_2O_3)_3^{4-}$ are not formed in significant quantities. The solubility product of $UO_2S_2O_3$ was calculated as $(3.83 \pm 0.27) \times 10^{-4}$ at 25°C. This reaction can not be used to determine uranium in solution. (TTT)

20172

EXTRACTION OF THORIUM AND ZIRCONIUM AS CHELATE COMPLEXES. V. I. Kuzhetsov and Ming-o Fang (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim. 5, 1375-82(1960) June. (In Russian)

Since Th and Zr tend to hydrolyze at low pH with the formation of basic salts that do not extract, it is important to select an organic complexing agent that will form complexes with these elements at as low a pH as possible. Standard solutions of thorium nitrate in 0.1 N HCl (Th–100 γ/ml) and of $ZrOCl_2 \cdot 8H_2O$ in 6.0 N HCl (Zr = 100 γ/ml) were employed. Various polynitro organic compounds were used as complexing agents in 10 fold excess as 0.002 M solution in cyclohexanone. The acidity was controlled by addition of an acetate buffer (pH of 3.5 to 6.0) or of free acid (pH < 3.5). Thorium and zirconium were determined photometrically in the extracts by the new reagent arsenazo II for thorium and by arsenazo for zirconium. It was found that thorium is quantitatively extracted at a pH > 1.5 to 2.5 by cyclohexanone solutions of a number of organic compounds obtained by diazo coupling of picric acid or dinitro aniline with β-naphthol, salicylic acid, 8-hydroxyquinoline, and other phenols. Zirconium is quantitatively extracted by a number of these organic compounds at a pH > 3. Organic reagents containing nitro groups can be useful not only for extracting thorium and zirconium, but also other elements which are hydrolyzed in acid solution. Replacement of a phenyl group by a naphthyl group decreases the number of nitro groups required and increases the stability of the organic reagent. It is possible to combine nitro groups with other electron-accepting substituents in the same molecule and thus improve the extraction efficiency. (TTT)

General Inorganic and Physical Chemistry

20173 CEA-Bib-3

France. Commissariat à l'Energie Atomique, Paris.

RÉACTIONS D'ÉCHANGÉ ISOTOPIQUE ENTRE L'AMMONIAC ET L'HYDROGENE OU DES COMPOSÉS HYDROGÉNÉS. (Isotopic Exchange Reactions between Ammonia and Hydrogen or Some Hydrogen Compounds). M. Heuberger and F. Botter. 1959. 25p.

This bibliography is concerned with hydrogen-deuterium exchange reactions in ammonia. It covers the period from 1933 to 1959 and includes 96 references. (auth)

20174 HW-30039

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

WET FLUORIDE STUDIES: CALCIUM PLUTONIUM(IV) FLUORIDE. P. B. Branin. Dec. 22, 1953. Decl. Mar. 15, 1960. 9p. Contract W-31-109-Eng-52. OTS.

Laboratory studies have shown that the double salt, $CaF_2 \cdot PuF_4$, can be precipitated by rapid addition of HF to solutions containing 25 to 75 g Pu/l, Ca equimolar to Pu, and 1 to 10M HNO_3. The precipitate, which is subsequently washed with water and dried to 300°C in dehumidified, deoxygenated Ar, can be reduced thermally by Ca to give high yields of Pu metal. (auth)

20175 NAA-SR-5334

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

LIQUIDUS CURVES FOR MOLTEN ALKALI METAPHOSPHATE–SULFATE SYSTEMS. S. W. Mayer, T. H. Mills, R. C. Alden, and B. B. Owens. July 30, 1960. 15p. Contract AT-11-1-GEN-8. OTS.

Liquidus curves for the $NaPO_3$-Na_2SO_4, $RbPO_3$-Rb_2SO_4, and $RbPO_3$-Na_2SO_4 systems were determined by gradient-furnace, visual, and thermal analysis techniques. The liquidus curves are compared with those for the $LiPO_3$-Li_2SO_4, KPO_3-K_2SO_4, and KPO_3-Li_2SO_4 systems. All these alkali metaphosphate-sulfate systems with a common cation are of the single eutectic type, and exhibit constant activation energy for viscous flow. The reciprocal systems, however, form intermediate solid compounds. Results of $NaPO_3$ chain-length measurements along the $NaPO_3$-Na_2SO_4 liquidus agree, qualitatively, with chain-length estimates based on the freezing-point depression of Na_2SO_4. (auth)

20176 NAA-SR-5394

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THE THERMOSTABILITY OF THORIUM TETRAIODIDE. A. L. Landis and A. J. Darnell. July 30, 1960. 15p. Contract AT-11-1-GEN-8. OTS.

The thermodynamic stability of solid ThI_4 was determined by measuring the equilibrium partial pressure of TiI_4 for the TiO_2–ThI_4 system at 637 to 745°K and the sublimation pressure of TiI_4 at 365 to 413°K by the Knudsen method. The pressure in atmospheres of TiI_4 over the TiO_2 to ThI_4 system and the sublimation pressure of TiI_4 are listed. (auth)

20177 TID-6125

Johns Hopkins Univ., Baltimore.

ABSORPTION AND FLUORESCENCE SPECTRA OF URANIUM SALTS AND OTHER SOLIDS SPECTRA OF MOLECULES CONTAINING TRITIUM X. Annual Report. G. H. Dieke. June 23, 1960. 23p. Contract AT(30-1)-1447. OTS.

A summary of activities during the period is presented. A study of absorption and fluorescence spectra of the crystalline rare earth and actinide salts is reported. The spectrum of the hydrogen molecule and its isotopic species was also studied. A review of other problems and projected work is included. (auth)

20178 CEA-tr-A-464

PRÉPARATION DU NITRURE DE BORE, D'ALUMINUM DE GALLIUM ET D'INDIUM D'APRÉS PROCÉDÉ VAN ARKEL DE BOER. (Preparation of Nitrides of Boron, Aluminum, Gallium, and Indium by the Process of Van Arkel de Boer.) Th. Renner. Translated into French from Z. anorg. u. allgem. Chem. 298, 22-33(1959). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9782.

20179

X-RAY POWDER DIFFRACTION STUDIES OF HAFNIUM TETRAIODIDE. Brigitte Krause, A. B. Hook, F. Wawner, and Hyman Rosenwasser (Engineer Research and Develop-

ment Labs., Ft. Belvoir, Va.). Anal. Chem. 32, 1210-11 (1960) Aug.

HfI_4 was prepared by direct combination of the elements and powder diffraction photographs were made. A table is presented for the d-values, observed relative intensities, proposed indices, and calculated lattice constants of HfI_4. It is concluded that the I atoms are arranged in a cubic close-packed lattice with the Hf atoms occupying $\frac{1}{8}$ of the tetrahedral holes, and that there are 8 HfI_4 molecules per cell. (D.L.C.)

20180

THE BEHAVIOR OF FISSION PRODUCTS CAPTURED IN GRAPHITE BY NUCLEAR RECOIL. II. THE DIFFUSION OF XENON-135 IN GRAPHITE AT A HIGH TEMPERATURE. Toshio Nakai, Seishi Yajima, and Koreyuki Shiba (Japan Atomic Energy Research Inst., Tokyo) and Jiro Osugi and Daisaburo Shinoda (Kyoto Univ.). Bull. Chem. Soc. Japan 33, 497-501(1960) Apr.

The diffusion at 400, 800, and 1200°C of xenon-135 captured in graphite powder was studied. The results showed two mechanisms for diffusion in a graphite grain: rapid and slow. The amounts of diffusion from natural graphite samples were appreciably greater than those from artificial graphite or the amorphous carbon samples. A diffusion constant, D, was found by the equation $D = D_0 \exp(-\Delta H/RT)$, where D_0 is the diffusion constant at 0°K, R is the gas constant, T is absolute temperature, and H is activation energy. (M.C.G.)

20181

THERMAL CONDUCTIVITY AND EUCKEN-TYPE FACTOR FOR THE BINARY MIXTURES H–He, H–Ne, H–Kr AND H–Xe. A. K. Barua (Indian Assn. for the Cultivation of Science, Calcutta). Indian J. Phys. 34, 169-83(1960) Apr. (In English)

In order to test the recent formulas for the thermal conductivity of polyatomic gas mixtures, the thermal conductivities of H_2–He, H_2–Ne, H_2–Kr, and H_2–Xe mixtures were measured at 30 and 45°C by using the thick-wire-variation of the hot-wire method. The experimental values of the thermal conductivity of the pure gases and their binary mixtures is lower than those given by Hirschfelder's theory based on the local chemical equilibrium assumption. It is suggested that this discrepancy between theory and experiments at the temperatures under consideration is due to the non-validity of the condition of local chemical equilibrium. Apart from this drawback Hirschfelder's theory has been found to represent the concentration dependence of the thermal conductivity of polyatomic gas mixtures quite satisfactorily. The more rigorously derived formula of Hirschfelder is found to represent the thermal conductivity of gas mixtures better than the approximate equation of Mason and Saxena. (auth)

20182

THE EQUATION OF STATE OF DEUTERIUM. V. A. Rabinovich (Inst. of Marine Engineering, Odessa). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 6, 107-11(1960) June. (In Russian)

An equation of state derived according to a recently developed method is proposed for deutrium. The equation describes the thermal and caloric properties with a high degree of accuracy for zero density to 2.0 times the critical density. (auth)

20183

TEMPERATURE DEPENDENCE OF YOUNG'S MODULUS OF VITREOUS GERMANIA AND SILICA. S. Spinner and G. W. Cleek (National Bureau of Standards, Washington, D. C.). J. Appl. Phys. 31, 1407-10(1960) Aug.

The temperature dependence of Young's modulus of vitreous GeO_2 was determined by a dynamic resonance method from –195°C to 540°C. The modulus increases with increasing temperature from about –120°C to 400°C. Below and above this range the modulus decreases with increasing temperature. Young's modulus for vitreous SiO_2 also increases from about –190°C to 1175°C and decreases with increasing temperature outside this range. In view of the similarity in structures and bond energies of these two materials, the similarity in the elastic modulus-temperature relations is believed to be significant; especially when contrasted with the lack of agreement in another commonly measured anharmonic property, thermal expansion. (auth)

20184

SOLUBILITY OF NEODYMIUM OXALATE BY COPRECIPITATION WITH Pm-147. Arthur Bradley and Harold T. Peterson, Jr. (Associated Nucleonics, Inc., Garden City, N. Y.). J. Chem. Educ. 37, 398-9(1960) Aug.

The solubility of neodymium oxalate was measured by coprecipitation with promethium-147. Neodymium oxalate was precipitated from an excess of aqueous oxalic acid containing Pm^{147} by adding neodymium chloride in solution. The reaction mixture was warmed to 80°C for one hour and allowed to stand at room temperature overnight. The precipitate was separated by filtration and aliquots of the filtrate were evaporated on planchets for counting. The solubility S was derived from the equation xy = ST where x was initial carrier concentration, y was tracer left in filtrate, and T was initial tracer added. The value obtained for S was 3.5×10^{-6} mole/liter of Nd^{3+}. (M.C.G.)

20185

AN ELECTROCHEMICAL STUDY OF URANIUM IN FUSED CHLORIDES. Derek L. Hill, Jeanne Perano, and Robert A. Osteryoung (Rensselaer Polytechnic Inst., Troy, N. Y.). J. Electrochem. Soc. 107, 698-705(1960) Aug.

The U(III)–U(0) and U(IV)–U(III) standard potentials in $MgCl_2$–NaCl–KCl eutectic, and the U(IV)–U(III) and UO_2(VI)–UO_2(IV) standard potentials in LiCl–KCl eutectic were measured at 450°C. The values found were respectively, –2.25, –1.30, –1.25, and –0.285 v vs. the standard Pt(II)–Pt(0) reference electrode on the mole-fraction scale. Polarographic studies of the behavior of U(III), U(IV), and UO_2(VI) in LiCl–KCl eutectic at 450°C were performed. The significance of the results with respect to certain industrially important processes was briefly noted. A coulometric titration procedure utilizing electrogenerated Pt(II) was developed for an in situ determination of U(III) in LiCl–KCl and $MgCl_2$–NaCl–KCl eutectics. (auth)

20186

THE PREPARATION OF HIGH PURITY VANADIUM PENTOXIDE BY A CHLORINATION PROCEDURE. Robert E. McCarley and James W. Roddy (Ames Lab., Ames, Iowa). J. Less-Common Metals 2, 29-35(1960) Feb. (In English)

A method for the preparation of high-purity V_2O_5 from a technical grade oxide was developed. The method includes the reaction of the impure oxide with Cl and C, hydrolysis of the resultant $VOCl_3$ in aqueous NH_3, and ignition of the precipitated NH_4VO_3 at 500 to 600°C. V_2O_5 containing a maximum of ~100 ppm impurities was produced in kilogram quantities both cheaply and efficiently by this process. (auth)

20187

WAVE NUMBERS, ROTATIONAL DISTORTION, CONSTANTS AND THERMODYNAMIC PROPERTIES FOR NT_3, PT_3, AND AsT_3. S. Sundaram and Forrest F. Cleveland

(Illinois Inst. of Tech., Chicago). J. Mol. Spectroscopy 5, 61-4(1960) July. (In English)

The harmonic wave numbers for NT_3, PT_3, and AsT_3 were calculated by use of the potential energy constants obtained for corresponding hydrides and deuterides. The anharmonicity factors and therefore the expected spectral frequencies were evaluated. A first-order perturbation calculation of the rotational distortion constants for the molecules was made. The molar thermodynamic properties were obtained from 100 to 1000°K for a rigid-rotor, harmonic-oscillator approximation at 1-atmos pressure. (auth)

20188

METALLOGRAPHIC DETERMINATION OF THE UO_2–U_4O_9 PHASE DIAGRAM. B. E. Schaner (Westinghouse Electric Corp., Pittsburgh). J. Nuclear Materials 2, 110-20(1960) June. (In English)

The UO_2–U_4O_9 equilibrium phase diagram was established by using metallographic techniques. Data obtained from visual examination of the microstructure of annealed and quenched samples made from dense solid pieces of UO_2 were used to determine the solubility of U_4O_9 in UO_{2+x} as a function of temperature. Two phases, UO_2 and U_4O_{9-y}, were found to exist at room temperature between O/U ratios of 2.00 and 2.22, although at temperatures over 940°C only a single phase is present. There is a wide range of UO_{2+x} between O/U ratios of 2.000 and 2.194 at temperatures between 200° and 950°C. In addition, a range of substoichiometric U_4O_9 lies between 2.25 and 2.20 at 940°C and to 2.22 at room temperature. (auth)

20189

PREPARATION OF LITHIUM DEUTERIDE. I. A. Khan, Y. W. Gokhale, and D. Sen (Atomic Energy Establishment, Trombay, India). J. Sci. Ind. Research (India) 19B, 166-8(1960) May. (In English)

Lithium deuteride was prepared by passing deuterium gas over lithium metal heated to 750°C. The product was a white crystalline solid. Deuterium gas for the reaction was prepared by the electrolysis of heavy water. with potassium sulfate used as an electrolyte. (auth)

20190

THE ANION EXCHANGE BEHAVIOR OF CERIUM, THORIUM, AND URANIUM IN CONCENTRATED ELECTROLYTES. D. Naumann and R. Ross (Zentralinstitut fur Kernphysik, Dresden). Kernenergie 3, 425-8(1960) May. (In German)

The ion exchange behavior of UO_2^{2+}, U^{4+}, Th^{4+}, and Ce^{3+} in concentrated electrolytes such as HNO_3, H_2SO_4, and ammonium salts of these acids was studied by determining their ion-exchange distribution coefficients. The separation results thus obtained are given. (tr-auth)

20191

"ENTHALPY TITRATIONS" AND THERMOCHEMISTRY IN MOLTEN SALTS. Joseph Jordan, Jurg Meier, Edward J. Billingham, Jr., and James Pendergrast (Pennsylvania State Univ., University Park). Nature 187, 318-19(1960) July 23.

A method is described which yields quantitative information on the chemistry of fused salts. Significant thermochemical results involving the precipitation of silver halides and silver chromate are summarized. A typical titration curve of chromate with silver, obtained under essentially adiabatic conditions, is illustrated. The data which can be inferred from a judicious interpretation of the titration curves are discussed. A representative set of results are included for thermometric titrations at 431°K. (B.O.G.)

20192

PRODUCTS OF THE REACTION OF METALLIC TITANIUM WITH TITANIUM TETRACHLORIDE. L. V. Biryukova and Yu. G. Saksonov. Zhur. Neorg. Khim. 5, 993-8(1960) May. (In Russian)

Spongy titanium metal was reacted with $TiCl_4$ in a heated quartz tube at 300 to 1000°C at contact times of 15 to 360 minutes, and the reaction products were subjected to chemical and x-ray analyses. At 300°C there is no reaction, at 400°C $TiCl_3$ is formed, at 500°C a mixture of $TiCl_3$ and $TiCl_2$, and at 600°C primarily $TiCl_2$. At 700°C and higher the α form of $TiCl_3$ is volatilized. X-ray data on two modifications of $TiCl_2$ are presented. The modification designated as $TiCl_2$-1 is formed at 600°C or lower, but at higher temperatures it is rapidly converted to a modification designated as $TiCl_2$-2. A sample of $TiCl_2$-1 was heated in a sealed quartz tube for 8 hours, and the conversion to $TiCl_2$-2 was observed by x-ray analysis. The x-ray characteristics of $TiCl_2$-1 are close to those obtained by Farber for $TiCl_3$, while the x-ray data for $TiCl_2$-2 are close to those obtained for $TiCl_2$ by Farber. (TTT)

20193

SOLUBILITY OF THORIUM PYROPHOSPHATE IN ACIDS AND INVESTIGATION OF THE EQUILIBRIA EXISTING BETWEEN THE SOLID PHASE AND SOLUTION IN THE SYSTEMS ThP_2O_7–$Na_4P_2O_7$–H_2O AND ThP_2O_7–$Th(NO_3)_4$–H_2O. F. M. Filinov, E. N. Tekster, A. S. Kolpakova, and E. P. Panteleeva (Lensovet, Leningrad Inst. of Tech.). Zhur. Neorg. Khim. 5, 1149-56(1960) May. (In Russian)

ThP_2O_7 tagged with UX_1 tracer to give 5×10^5 disintegrations per minute per gram of ThP_2O_7 was used to determine the solubility of ThP_2O_7 in 0.1 to 0.5 N HCl, HNO_3, and H_2SO_4. The solubility increased linearly with increasing acid concentration with the largest solubility being observed in H_2SO_4 (rising from 4×10^{-4} mol/l of ThP_2O_7 at 0.1 N to 8.5×10^{-4} mol/l at 0.5 N H_2SO_4). In studying the solubility of ThP_2O_7 in 0.02 to 0.2 mol/l of $Na_4P_2O_7$, it was observed that the solubility increases linearly up to 0.05 M $Na_4P_2O_7$ (mol ratio of pyrophosphate to thorium in solution = 2). Above 0.05 M $Na_4P_2O_7$ there was a gradual decrease of thorium in solution accompanied by the appearance of a flocculent precipitate with the composition $Na_4[Th(P_2O_7)_2] \cdot 6\ H_2O$ that was different from the amorphous precipitate ThP_2O_7. The solubility of $Na_4[Th(P_2O_7)_2] \cdot 6\ H_2O$ in water at 18°C was found to be 4.22×10^{-3} mol/l. The strength of the complex is attested to by the fact that Th^{+4} could not be precipitated by NH_4OH, KIO_3, $H_2C_2O_4$, H_2O_2, or $K_4[Fe(CN)_6]$ from aqueous solutions of $Na_4[Th(P_2O_7)_2]$. From conductivity measurements in very dilute solutions it is estimated that the instability constant K for the reaction $[Th(P_2O_7)_2]^{4-} \rightleftharpoons ThP_2O_7 + P_2O_7^{4-}$ is 4.9 to 6.5×10^{-6}. Conductometric titration curves were drawn in titrating 0.002 M $Na_4P_2O_7$ with a 0.0682 M $Th(NO_3)_4$ solution and a 0.0014 M $Th(NO_3)_4$ with a 0.1 M $Na_4P_2O_7$ solution. Reproducible breaks in the conductance at a ratio of pyrophosphate to thorium = 2, corresponding to formation of the $[Th(P_2O_7)_2]^{4-}$ complex; at a ratio = 1, corresponding to the formation of ThP_2O_7; and at a ratio = 0.7 to 0.8, corresponding to the possible existence of a $[Th_3(P_2O_7)_2]^{4+}$ complex. The solubility of ThP_2O_7 in $Th(NO_3)_4$ solutions was found to increase slowly with time. Addition of a saturated solution of K_2SO_4 gave a precipitate that was found to contain phosphate. Further investigation of the system ThP_2O_7–$Th(NO_3)_4$–H_2O is necessary. (TTT)

20194

SOLUBILITY PRODUCT OF URANIUM(IV) OXALATE, COMPOSITION AND DISSOCIATION CONSTANTS OF

U(IV) OXALATE COMPLEXES IN AQUEOUS SOLUTIONS. F. A. Zakharova and A. I. Moskvin (Inst. of Physical Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim. 5, 1228-33(1960) June. (In Russian)

The solubility product of $U(C_2O_4)_2 \cdot 6H_2O$ was found to be $4.3 \pm 0.4 \times 10^{-22}$ from solubility determinations in 0.1 to 3.0 N HCl solutions. The following oxalate complexes are formed in oxalate solutions: $[U(C_2O_4)]^{2+}$, $[U(C_2O_4)_2]^0$, $[U(C_2O_4)_3]^{2-}$, and $[U(C_2O_4)_4]^{4-}$ whose respective instability constants are 2.5×10^{-9}, 1.4×10^{-17}, 1.7×10^{-23} and 5.7×10^{-28}. (TTT)

20195

SOLUBILITY STUDIES IN THE $Ce(ClO_4)_3-HClO_4-H_2O$ TERNARY SYSTEM AT 20° AND AT 0°C. A. A. Zinov'ev and N. A. Shchirova. Zhur. Neorg. Khim. 5, 1299-1303 (1960) June. (In Russian)

The crystal hydrates $Ce(ClO_4)_3 \cdot 8H_2O$ and $Ce(ClO_4)_3 \cdot 9H_2O$ of trivalent Ce, previously mentioned in the literature, were found to form very hygroscopic ice-like crystals, decomposing upon heating into CeO_2. In addition, the existence of the previously unknown anhydrous salt of the tetrahydrate and of metastable $Ce(ClO_4)_3 \cdot 5H_2O$ was also established. As a general rule, the salts of trivalent Ce do not seem to hydrolyze easily, making it possible to prepare the neutral sulfates, nitrates, and other neutral salts. Ce^{3+} does not display a noticeable tendency toward complex formation, although it forms binary salts quite easily. Distilled pure $HClO_4$ and $CeCl_3 \cdot 6H_2O$ were used as raw materials for the work. On the basis of solubility measurements, obtained from determination of the solid phases, the triangular phase diagrams of the system $Ce(ClO_4)_3 = HClO_4-H_2O$ were plotted for the temperatures 0° and 20°C, using a Dewar flask filled with ice for 0° and a water thermostat adjusted to ±0.2° for measurements at 20°C. (TTT)

20196

REVIEW OF INVESTIGATIONS ON THE FIELD OF THE ELECTROCHEMISTRY OF MOLTEN SALTS FOR THE YEAR OF 1959. A. G. Morachevskiĭ. Zhur. Priklad. Khim. 33, 1434-48(1960) June. (In Russian)

The current literature on molten salts is reviewed in detail under the following section headings: Electrical Resistance and Transfer Numbers; Electromotive Forces of Galvanic Cells with Molten Salts; Reference Electrodes Used in Electrochemical Studies of Molten Salts; Polarographic Research on the Field of Molten Salts; Investigations on the Field of the Electrochemical Preparation of Aluminum, Magnesium, Sodium, and Lithium; Preparation of Alloys by the Electrolysis of Molten Salts Using a Liquid Cathode and Electrolysis with a Dissolved Liquid Anode; Electrolysis of Molten Salts Under Formation of Solid Metals at the Cathode (including subheadings for the elements Ti, Zr, Th, U, Be, Pu, and B); Preparation of Alloys by Means of Electrolysis of Molten Salts Using a Solid Cathode; and Galvanic Coatings from Molten Electrolytes. (293 references.) (TTT)

Radiation Chemistry and Radiochemistry

20197 BNL-612

Brookhaven National Lab., Upton, New York.

GAMMA IRRADIATION EXPERIMENTS IN THE N_2-O_2 SYSTEM. Report No. 1 [on] RADIATION PROCESSING. M. Steinberg. June 1960. 20p. OTS.

Static radiation experiments were performed on the N_2-O_2 system in a Co^{60} gamma field. The ratio of the decomposition products, N_2 to O_2 to NO_2 were found to be in the order of 1 to 0.09 to 0.46. The G values for N_2O decomposition, N_2, and NO_2 formation, are in the order of 11.3, 9.3, and 4.18 in the range of 10^6 to 10^8 Rad. A dose dependence tending to decrease the $G(N_2)$ and $G(N_2O$ dec.) was noted. The $G(NO_2)$ appeared to be constant over the range studied. Irradiation of 78% $N_2-22\%$ O_2 mixtures in glass at 27°C and at pressures of 2.9 to 12 atm resulted in $G(NO_2)$ values in the range of 0.9 to 1.6. The $G(N_2O)$ values are roughly one-third those of the $G(NO_2)$ values. Preliminary experiments in stainless steel vessels at pressures of 68 atm and at temperatures ranging up to 538°C (1000°F) gave G values in the order of 0.6 to 1.2. Part of the fixed nitrogen was found on the walls of the vessel. Some iron oxide formation was noted, and CO_2 was detected in the gas phase, which indicate that the walls of the containing vessel entered into the reaction. For purposes of reducing or eliminating wall reactions, experiments in pressure equalized glass vials were carried out at a pressure of 68 atm (1000 psi) and at a temperature of 800°F. $G(NO_2)$ values ranging from 0.4 to 0.9, increasing with dose, were obtained. Effects of solid surfaces on the N_2-O_2 reaction in a gamma field at 3 atm and 22°C indicated that U_3O_8, stainless steel, and Cr tend to decrease the $G(NO_2)$ values, and soft glass, Ni, Fe_2O_3, and Al_2O_3 tended to increase the G values. (auth)

20198 BNL-613

Brookhaven National Lab., Upton, New York.

IRRADIATION OF NH_3-H_2O SOLUTIONS FOR FORMATION OF HYDRAZINE. Report No. 2 [on] RADIATION PROCESSING. M. Steinberg. June 1960. 10p. OTS.

Irradiation tests of NH_3-H_2O in a stainless steel container in a Co^{60} gamma field indicated that the G value for hydrazine formation varies with ammonia concentration. A sharp maximum $G(N_2H_4)$ value of 0.28 is obtained in the concentration range of 60 to 70% NH_3 in aqueous solution, which is about 30 to 40 times the value obtained for 28% aqua ammonia and for 100% liquid ammonia. (For report number 1 see BNL-612.) (C.J.G.)

20199 CEA-1420

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay.

RADIOLYSE DES SOLUTIONS AQUEUSES DE PLUTONIUM. (Radiolysis of Aqueous Solutions of Plutonium). Monique Pagès. 1960. 73p.

Thesis submitted to the Univ. of Paris.

The effects of gamma rays on plutonium aqueous solutions at various valency states in the presence of sulfuric, perchloric, nitric, and hydrochloric acids are studied. The main feature is the reduction of Pu(VI) into Pu(V) followed by dismutation from V to IV and VI. For sulfuric and perchloric acid solutions (0.2 N) the following process is given: radiolysis of water produces OH, H_2O_2, H, and H_2. H and H_2O_2 reduce Pu(VI) while Pu(V) is oxidized by OH radicals. However, the reaction of hydrogen peroxide is slow and leads to an after effect. A parallel study of the action of H_2O_2 has given a confirmation. Spectrophotometric measurements were carried out on disappearance of Pu(VI) and formation of Pu(IV) and it was possible to make determination of $G_{H_2O_2} = 0.8$ and $G_H - G_{OH} = 0.8$. $G_{H_2} = 0.41$ was measured by gas analysis. The calculation of G_{H_2O} gave 4.35. The reoxidation of Pu(V) is dependent on the concentration of sulfate ions. In perchloric acid solution reduction goes on to Pu(III). Cl^- and NO_3^- ions inhibit the reduction and even suppress it. The effect of alpha particles, both from plutonium and from polonium is very simi-

lar to the effect of hydrogen peroxide. Induction times were observed mainly in presence of HSO_4^-, depending on the accumulation of H_2O_2 and (or) of plutonium peroxide. At low acidities, Pu(IV) peroxide seems to lead to polymer forms. (auth)

20200 DP-494

Du Pont de Nemours (E.I.) & Co. Savannah River Lab., Aiken, S. C.

PRECIPITATION OF RADIORUTHENIUM. Frank E. Butler. June 1960. 11p. Contract AT(07-2)-1. OTS.

Methods for quantitative precipitation of radioruthenium as the sulfide by thioacetamide, thiourea, thiophenol, β-mercaptopropionic acid, and 2,3-dimercaptopropane are described. A procedure is described for the specific determination of Ru in an acid solution of mixed fission products and induced activities. (C.J.G.)

20201 NAS-NS-3012

National Research Council. Committee on Nuclear Science.

THE RADIOCHEMISTRY OF ASTATINE. Evan H. Appelman, Argonne National Lab. Mar. 1960. 33p. OTS.

Its Nuclear Science Series.

An intensive treatment of the chemistry of At is presented. Because At has no long-lived isotopes, its concentration is usually on the order of 10^{-15} M and reactions with impurities of the same concentration complicate chemical studies. The different oxidation states of At and their extractability are discussed together with their known potentials. Astatine may be prepared by alpha bombardment of bismuth, and methods of isolation from the target and assay are given. Several radiochemical procedures are given for the determination of At in biological materials. (D.L.C.)

20202 ORNL-2928

Oak Ridge National Lab., Tenn.

PURIFICATION OF KILOCURIE QUANTITIES OF PROMETHIUM-147 BY ION EXCHANGE. R. S. Pressly, C. L. Ottinger, P. B. Orr, and E. E. Beauchamp. July 19, 1960. 11p. Contract W-7405-eng-26. OTS.

Twenty thousand curies of Pm^{147} in a mixture of rare-earth fission products were processed by ion exchange on a cation resin, using ammonium citrate solution as the eluant, until the desired purity of Pm^{147} was obtained. Promethium was present to the extent of about 1.6% in the starting mixture and was increased to 60% in the final product. Procedures, typical elution curves, methods of analysis, and a description of the equipment are given for the process. It is concluded that multikilocurie quantities can be produced with similar equipment, with little difficulty contributed by radiation or radiation damage when feed material of the appropriate concentration is available. (auth)

20203

OXIDATION OF FERROUS IONS IN THE AQUEOUS FERROUS-CUPRIC SYSTEM. I. EFFECT OF COBALT-60 GAMMA-RAYS. Hiroshi Hotta, Akira Terakawa, and Shinichi Ōno (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan 33, 442-5(1960) Apr.

The oxidation of ferrous ions in aqueous ferrous-cupric systems by cobalt-60 gamma rays was studied in order to find a good chemical dosimeter for high doses. The solutions were saturated with nitrogen or oxygen, or left untreated. An untreated aqueous solution of 0.04M ferrous ammonium sulfate containing 0.8N sulfuric acid and 0.001M cupric sulfate gave the best results. The G Values were found to be dependent upon the composition of the solution. (M.C.G.)

20204

THE BEHAVIOR OF FISSION PRODUCTS CAPTURED IN GRAPHITE POWDER BY NUCLEAR RECOIL. I. THE STABILITY OF THE FISSION PRODUCTS TOWARD NITRIC ACID SOLUTION. Toshio Nakai, Seishi Yajima, and Koreyuki Shiba (Japan Atomic Energy Research Inst., Tokyo) and Jiro Osugi and Daisaburo Shinoda (Kyoto Univ.). Bull. Chem. Soc. Japan 33, 494-7(1960) Apr.

The variation, at various cooling times after irradiation, of the gamma spectra of fission products captured in graphite powder by nuclear recoil was investigated. The stability of the captured fission products toward nitric acid of several different concentrations was also studied. Fission products captured in graphite were leached with difficulty in a nitric acid solution under various conditions of immersion. The leaching was slightly increased with increased acid concentration. However, there was no difference due to varying the graphite samples and the immersion times. When the samples were heated to a high temperature, the leaching of fission products increased with acid concentration. (M.C.G.)

20205

EFFECT OF METAL IONS ON THE RADIATION-INDUCED DECARBOXYLATION OF AQUEOUS BENZOIC AND SALICYLIC ACID SOLUTIONS. Akira Sugimori and Genichi Tsuchihashi (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan 33, 713-14(1960) May. (In English)

The effects of heavy metal ions on radiation-induced decarboxylation of benzoic and salicylic acids were studied in order to determine the difference in effects of bound and non-bound metal ions. Benzoic acid did not form stable chelate compounds with metal ions, but salicylic acid gave stable complexes with Fe^{3+}, Cu^{2+}, and Al^{3+}. $G(CO_2)$ values were measured volumetrically. For benzoic acid, Fe^{3+} caused a decrease in $G(CO_2)$, while for salicylic acid, it made $G(CO_2)$ remarkably high. The effects of Fe^{2+}, Cu^{2+}, Al^{3+}, Co^{2+}, N^{2+}, Zn^{2+}, Mg^{2+}, and H_2SO_4 on $G(CO_2)$ values for salicylic acid were also determined. (M.C.G.)

20206

THE EFFECT OF RADIOACTIVE RADIATION FROM A SOLID ON ITS SOLUTION PROCESSES. V. I. Spitsyn, E. A. Torchenkova, and I. N. Glazkova (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 132, 643-5(1960) May 21. (In Russian)

The influence of specific radioactivity of barium sulfate labeled with S^{35} on dissolving kinetics and magnitude in water was studied by visual-microscopic (1200x) and electron-microscopic methods (1200x) with 2.7 to 8.1 μ $BaSO_4$ particles at 20 ± 0.5°. (R.V.J.)

20207

RADIATION TECHNOLOGY FOR NONBIOLOGICAL MATERIALS. A. J. Restaino (Atlas Powder Co., Plainsboro, N. J.). Ind. Eng. Chem. 52, 683-7(1960) Aug.

A review was made of those radiation processes which yielded end products for which a use, need, or market existed and for which the costs involved were competitive for making the same or similar products by non-radiation techniques. Polymerization, chlorination of benzene, and sulfochlorination of cyclohexane were among the chain reactions initiated by high-energy radiation. Cross-linkage of polymers by radiation was studied, but the polymers had few important applications. Nonchain chemical synthesis by radiation was also investigated. In most cases the costs of the radiation processes were unable to compete with already existing chemical processes. (M.C.G.)

20208

NEUTRON ACTIVATION EXPERIMENTS IN RADIOCHEMISTRY. Karl S. Vorres (State Univ. of Iowa, Iowa City). J. Chem. Educ. 37, 391-5(1960) Aug.

Neutron activation experiments designed for radiochemistry courses are described. Two neutron sources were used. One was a model 9000 Nuclear Chicago water-moderated subcritical reactor utilizing five one-curie plutonium–beryllium sources. The other was a paraffin-moderated reactor made from the source shipping container and a single one-curie source. After being given sample size and neutron flux, the students were asked to find two isotopes that would give at least 100 disintegrations/min at the end of a 24-hr irradiation. Sample holders were made from polystyrene tubing. After irradiation, samples were characterized by determining the type of radiation, measuring the half life, and measuring the energy of radiation when possible. (M.C.G.)

20209

RADIATION EFFECTS ON POLYMER SYSTEMS. M. Magat (Lab. of Chemical Physics, Paris Inst. of Sciences, France). Khim. i Tekhnol. Polimerov No. 7-8, 102-12 (1960). (In Russian)

Data on radiation polymerization, presented at the symposium on macromolecular chemistry in Moscow, June 1960, are reviewed. Polymerization of vinyl monomers, preparation of grafted polymers, ion polymerization, and solid-phase polymerization were among the topics discussed. 48 references. (R.V.J.)

20210

THE ANTIFUNGAL PROPERTIES OF X-IRRADIATED ESSENTIAL OILS AND OIL COMBINATIONS. Jasper C. Maruzzella and Denis Scrandis (Long Island Univ., Brooklyn). Naturwissenschaften 47, 282(1960). (In English)

The effects of x radiation on the antifungal properties of caraway, myrrh, niaouli, origanum red, and peppermint oils and 25 combinations of these oils were studied. The results show a slight over-all increase in the zones of inhibition with the x-irradiated oils. The 25 combinations of untreated essential oils produced a decrease in antifungal activity as compared to each oil used separately. Similarly the 25 combinations of x-irradiated oils showed a decrease in antifungal activity as compared to each irradiated oil used separately. (J.S.R.)

20211

CHROMATOGRAPHIC PURIFICATION OF TECHNETIUM. A. F. Kuzina and V. I. Spitsyn (Inst. of Physical Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim. 5, 1006-12(1960) May. (In Russian)

Calculations show that the irradiation of 100 grams of MoO_3 for 70 days with thermal neutrons at a flux of 2.5×10^{13} neutrons/cm^2 sec should produce 0.35 milligrams technetium. The MoO_3 is dissolved in HNO_3 and neutralized with NH_4OH. Technetium is concentrated by coprecipitating with $MgHPO_4 \cdot 3H_2O$ or $MgNH_4PO_4$. The magnesium precipitate is dissolved in 6.0 N HCl and H_2S is passed through the solution to form the Tc(IV) chloro-complex. On the addition of NH_4OH magnesium precipitates as a phosphate, but does not carry technetium. The filtrate is evaporated to dryness. A dilute acid solution at pH = 2.0 is passed through the sulfonate cation exchanger KU-2 in the hydrogen form. Cations such as Fe, Ca, Sr, and Al and radioactive impurities such as Co^{60}, W^{181}, Zn^{65}, and Zr^{95} are adsorbed on the cation exchanger. Technetium passes through the column as an ion. Beta counting showed the technetium to be radiochemically pure, but spectral analysis showed the presence of small amounts of Fe, Ca, and Sr as impurities. The yield of technetium is as high as 90%. The loss of technetium by adsorption on the cation exchanger increases with decreasing concentration of technetium in the solution. (TTT)

20212

DECOMPOSITION OF PLUTONIUM OXALATE COMPOUNDS BY ALPHA RADIATION. L. P. Sokhina and A. D. Gel'man. Zhur. Neorg. Khim. 5, 1013-15(1960) May. (In Russian)

The compounds $Pu(C_2O_4)_2 \cdot 6H_2O$, $Na_4[Pu(C_2O_4)_4] \cdot 5H_2O$, $K_4[Pu(C_2O_4)_4] \cdot 5H_2O$, and $(NH_4)_6[Pu(C_2O_4)_5] \cdot nH_2O$ were found to be decomposed by alpha radiation. Plutonium oxalate and the ammonium oxalate compound were the least stable. The plutonium metal in the ammonium salt increased from 28 to 63.6% on standing for one year. The oxalate compound decomposed to $PuOCO_3$ $2H_2O$ on standing for $1\frac{1}{2}$ years. Oxalate ion is decomposed to CO and carbonate. Pu(IV) is reduced to Pu(III) by the CO, and remains as Pu(III) until all the oxalate is decomposed whereupon Pu(III) is oxidized to Pu(IV) again. A sample of Pu(IV) oxalate that had been stored eight months in a desiccator was dissolved in heated 4 N H_2SO_4. Large bubbles of CO_2 were observed and the color of the solution was not pink which is characteristic of Pu(IV), but rather a greenish-blue which is the color of Pu(III). Addition of NH_4OH gave a dirty-blue hydroxide precipitate. Magnetic susceptibility measurements showed 1.4 to 1.5 Bohr magnetrons for the Pu(IV) oxalate, 2.29 and 1.87 for the Pu(III) oxalate, and 1.85 for the decomposition product after eight months. Thus, the presence of Pu(III) is confirmed. The decomposition of the potassium and sodium oxalate complexes was entirely analogous, the final decomposition products being a mixture of $PuOCO_3$ and alkali carbonate. (TTT)

20213

SYNTHESIS OF GRAFTED COPOLYMERS BEGINNING WITH POLYMERS HAVING EXPERIENCED THE ACTION OF IONIZING RADIATION. III. COMPARATIVE STUDY OF GRAFTING TO POLYETHYLENE AND TO POLYPROPYLENE. A. Chapiro. p.156-66 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya III." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 470p. (In French)

The grafting of acrylonitrile to polyethylene and polypropylene films preliminarily subjected to gamma rays in air was investigated. All the conversion curves obtained on grafting acrylonitrile to polyethylene have a linear region, whereas the shape of the polypropylene curves changed with dosage. For small doses, the curves have an autoaccelerative character typical for reactions taking place with a "gel effect," whereas for enhanced doses the reaction proceeds at a high rate, but soon reaches a limit where grafting practically ceases. The amount of polyacrylonitrile formed in the reaction is considerably larger for grafting to polypropylene than to polyethylene. The polyethylene grafting rate is directly proportional to the dosage and varies with the intensity according to the equation: $V = KI^{0.85}$. The polypropylene rate varies to the 0.65 power of the initial dose and to the 0.6 power of the intensity. The effect of grafting temperature was investigated at 25 to 170°. A discussion is presented of the mechanisms of radiochemical peroxide formation in both polymers. (auth)

20214

ON THE STRUCTURE OF POLYETHYLENE GRAFTED BY A PREIRRADIATION TECHNIQUE. C. Sella. p.167-9 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi

Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya III." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 470p. (In French, Russian, and English)

The structure and morphology of copolymers obtained by grafting styrene, vinylacetate, vinyltoluene, acrylonitrile, and methylmethacrylate monomers to irradiated polyethylene were investigated with large and small angle x-ray analysis and electron microscopy. Conclusions drawn from the x-ray diagrams were confirmed by electron microscopy. In general the grafting reaction was heterogeneous, leading to the coexistence of three phases: non-grafted polyethylene, grafted copolymer, and homopolymer. Electron microscopy revealed the form and distribution of the precipitated homopolymer as a function of the grafting conditions and the preliminary thermal treatment of the graft copolymer. The various methods provide an approach to a number of problems of isomorphism and the effect of thermal treatment of the grated copolymer on its structure and physical and mechanical properties. (auth)

20215

RADIATION FOR COPOLYMERIZATION OF ACRYLONITRILE WITH POLYSTYRENE AND PERCHLOROVINYL. Kh. U. Usmanov, U. N. Musaev, and R. S. Tullaev. p.170-6 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya III." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 470p. (In Russian)

The results of the formation of graft polystyrene and perchlorovinyl polymers with acrylonitrile by gamma rays are presented. Swollen polystyrene film in acrylonitrile was subjected to doses of 10^6 to 4×10^6 r. The percentage of grafting increases with increasing dosage. The monomer unit to polymer ratio was determined from data on the nitrogen content. A graft polymer of perchlorovinyl and acrylonitrile was obtained by preliminary irradiation of perchlorovinyl in air. A thermomechanical property study showed that the graft polymers possessed greater thermal stabilities than the initial polymers. The radiation polymerization of acrylonitrile was studied, and the viscosities of the acrylonitrile solutions were measured. (auth)

20216

X RADIATION EFFECTS IN METHYLMETHACRYLATE GRAFTING TO POLYVINYL ALCOHOL FILMS. I. Santo and K. Gal. p.207-13 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya III." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 470p. (In Russian)

The possibility of converting polyvinyl alcohol films from water-soluble to water-insoluble by graft copolymerization is of practical interest. Graft polymerization of methylmethacrylate onto polyvinyl alcohol films was carried out. The influence of various methanol-methylmethacrylate mixtures on the grafting process was studied. The kinetics was studied dilatometrically, with periodic irradiation. It was established that polymerization slows down on interruption of irradiation, the rate of polymerization depends linearly upon time, and the greatest grafting effect (1700%) was observed at 20 to 30% methanol and continuous radiation. Some light was cast on the role of methanol in the grafting process, and the resultant products (radiation dose 4×10^4 r) are insoluble in water, acetone, and benzene. (auth)

20217

REACTIONS OF POLYMERIZATION AND DEGRADATION BY GAMMA-RAYS. C. Rossi and U. Bianchi. p.260-8 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya III." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 470p. (In English)

Studies of previous polymerization-degradation investigations of styrene polymers indicate that there exists an equilibrium molecular weight for each radiation intensity. To show the existence of such an equilibrium, a series of polymerizations and degradations was performed on styrene monomer and polymer in chloroform solutions at 37 and 60 r/min. The behavior of molecular weight with time was studied viscosimetrically. The abatement of the viscosity molecular weights obtained at I = 37 and 60 r/min is given graphically with the molecular weight as a function of exposure time. An extrapolation of the curves for $t = \infty$ gives the equilibrium molecular weights for the two intensities. There were: for 60 r/min, 180,000 and 185,000; and for 37 r/min, 290,000 and 300,000, for degradation and polymerization equilibrium molecular weights, respectively. (B.O.G.)

20218

INFLUENCE OF UNSATURATED GROUPS ON CROSSLINKING AND INHIBITION OF CRYSTALLIZATION IN THE GAMMA-RAY IRRADIATION OF LINEAR POLYETHYLENES. M. Dole, T. J. Stolki, and T. F. Williams. p.269-79 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya III." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 470p. (In English)

It was previously suggested that on irradiation the disappearance of vinyl unsaturation involved the formation of endlinks and that vinylene unsaturation disappeared by the formation of cross-links. The influence of decay of vinyl and vinylene groups is more clearly seen in the increase in the relative amorphous content than in crosslinking effects. Without consideration of vinyl decay, it would be most difficult to explain why the relative amorphous content rose so much faster in the sample of vinyl unsaturation than in vinylene unsaturation. The vinylene groups initially present in the samples do not decay by forming cross-links although these groups produced randomly throughout the polyethylene by irradiation may so decay. Whereas the trans-vinylene concentration may decline with dose because of partial isomerization to cis-vinylene groups or because of reduction by atomic or electronically excited molecular hydrogen, the evidence indicates the formation of end-links. (B.O.G.)

20219

TRANSFORMATION OF CARBOXYLATED BUTADIENE-STYRENE RUBBERS AND THEIR MIXTURES WITH ϵ-CAPROLACTAM UNDER THE EFFECTS OF γ-RADIATION. I. Mladenov, I. A. Tutorskiĭ, and B. A. Dogadkin. p.293-301 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya III." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 470p. (In Russian)

Carboxylated butadiene-styrene rubbers containing at 30% styrene, 1.30 and 1.60% methacrylic acid, and at 50% styrene, 2.88 and 5.34% methacrylic acid, were exposed to 0.1 to 50 mr doses of γ rays. This resulted in a fall in the

carboxyl group content, particularly in the case of small doses. The yield of cross-linked polymers at low doses is a linear function of the amount of carboxyl groups in the initial polymer. The number of cross-links formed by the carboxyl groups at doses to 20 mr calculated from maximum swelling data was found to agree with the amount calculated from the consumption of carboxyl groups. Irradiation of the carboxylated rubber in ε-caprolactam results in an addition-forming insoluble compound. The amount of combining increases with increases in the methacrylic acid content of the initial mixture, and there is an increase in the degree of cross-linking. An increase of bound ε-caprolactam content leads to an increase in the tensile strength of the polymer. (B.O.G.)

20220

MECHANISM OF PROTECTIVE ACTION OF BENZENE RINGS IN POLYSTYRENE RADIOLYSIS. A. N. Pravednikov and Sheng-k'ang Ying. p.433-9 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya III." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 470p. (In Russian)

The cross-linking energy in the radiolysis of polystyrene is 100 times that of polyethylene, whereas the free radical yield in the radiation of linear paraffins is only 5 to 6 times as much as that from alkylaromatic compounds. The high radiation stability of polystyrene can not be explained by the conventional scheme for the action of the benzene rings. The mechanisms of the reactions taking place during radiolysis of polystyrene are examined to explain its high radiation stability. Interactions between the primary radical and cyclohexadienyl, formed as a result of the rupture of a C—H bond due to radiation, which may take place are discussed. The mechanisms of the interactions between the primary and cyclohexadienyl radicals were investigated through the radiolysis of deuterated toluene, $C_6H_5CD_3$, at liquid nitrogen temperatures. Results showed that the rate of these processes should exceed at least 5 to 6 times the rate of the processes leading the cross-linkage. It is concluded that the stability is due to a considerable extent to disproportionation of the primary and cyclohexadienyl radicals. (auth)

20221

ACTION OF γ-RAYS FROM RADIOCOBALT ON AQUEOUS SOLUTIONS OF POLYOXYETHYLENEGLYCOL. C. Crouzet and J. Marchal. p.448-54 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya III." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 470p. (In French)

Irradiations of the samples were carried out in air and in evacuated tubes. The samples were prepared by precipitating methyl alcohol solutions with diethyl ether. The weight average molecular weights (M_w) were 15,000 and 20,000. In the air irradiations, oxidation degradation occurred which decreased the M_w to 3200 and 3800, respectively, for an absorbed dose of 3 megarads. In the irradiations involving evacuated tubes, the M_w initially increased and in some cases reached the gel point. For doses exceeding 3 megarads, the M_w decreased sharply attaining a value of 5000 for total dosage of 40 Mr at 65,000 r/hr. Two opposing mechanisms are demonstrated, one leading to crosslinking and the other to degradation. The significance of these mechanisms is discussed. (auth)

20222

RADIATION EFFECTS ON CARBON AND CARBON ION POLYMERIZATION MECHANISMS. A. D. Abkin, A. P. Sheinker, M. K. Yakovleva, and L. P. Mezhirova. p.410-19 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoĭ Khimiĭ, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya II." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 559p. (In Russian)

Data obtained from studies of the radiation polymerization of isobutylene, styrene, butadiene, and other monomers lead to the conclusion that under low-temperature conditions a cationic mechanism underlies the polymerization of these monomers. No anionic polymerization mechanisms under the action of nuclear radiations are described in the literature. Copolymerization mechanisms of styrene with isobutylene and methylmethacrylate and of acrylonitrile with styrene and methylmethacrylate initiated by gamma rays were investigated. The rate of polymerization of isobutylene and styrene was found to be proportional to the first degree of the dose rate. On the basis of the kinetic relations established and data from studies of such systems, a discussion is presented of the cationic and anionic mechanisms of γ-ray-induced polymerization. (B.O.G.)

20223

IRRADIATION OF ACRYLONITRILE IN THE SOLID STATE. R. Bensasson and R. Marx. p.420-6 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya II." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 559p. (In French)

The effect of temperature and dosage on irradiated solid acrylonitrile was investigated. The studies were made by methods of electron paramagnetic resonance and x-ray diffraction. Experimental data are discussed in connection with whether the polymerization takes place by ionic or radical mechanisms and whether the reaction takes place in the course of radiation, either in the solid phase or in microregions by fusion, or other irradiation. (auth)

20224

POLYMERIZATION OF FORMALDEHYDE INDUCED BY IONIZING RADIATION. C. Chachaty, M. Magat, L. Ter Minassian. p. 427-36 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya II." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 559p. (In French)

Gamma- and x-ray-induced formaldehyde polymerization was investigated at −75 to −196°C by thermal analysis. Enhanced percentages of conversion were obtained at dosages less than 2000 r. At lower temperatures the polymerization assumed an explosive character, either on heating or in the course of the irradiation, depending on the dosage. This was interpreted as a function of internal excitation caused by accumulation of growing chains. From the thermal explosion theory, the activation energy may be derived at about 3 kcal. At elevated temperatures a steady-state thermal polymerization may set in, since the chains are initiated and terminated in the course of the radiation. (auth)

20225

POLYMERIZATION OF VINYL ACETATE INDUCED BY GAMMA RAYS. H. A. Dieu, J. L. Orbiso, and V. Desreux. p. 437-45 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya II." Moscow, The International Union of Pure and Applied Chemistry, Com-

mission on Macromolecular Chemistry, 1960. 559p. (In French)

The mechanism of vinyl acetate polymerization by gamma rays was investigated to ascertain whether it was analogous to that due to ultraviolet radiation. The tests were conducted at −40 to 0° in the presence of a 170-c Co^{60} source at intensities of 2900 r/hr. The reaction was usually halted before 5% conversion took place and the unreacted monomer was distilled off. The residual polymer was dried in vacuo and the intrinsic viscosity was determined in acetone, benzene, and tetrahydrofuran. The effect of temperature on the structure was studied by converting the polymer to polyvinyl alcohol and determining the intrinsic viscosities and sedimentation constants. Then the polyvinyl alcohol was acetylated twice and the intrinsic viscosity of the resultant products was determined. The intrinsic viscosity of the specimens was less in acetone than in benzene and tetrahydrofuran, while the sedimentation constants were of the same magnitude. The results indicate that the linear dependence of polymer structures upon the temperature proposed by Melville et al. holds for polymerization by γ rays. (auth)

20226

SOME OBSERVATIONS ON THE RADIOCHEMICAL POLYMERIZATION OF ACRYLONITRILE. A. Bernas and M. Bodard. p.446-52 of "Mezhdunarodnyi Simpozium po Makromolekulyarnoi Khimii, SSSR, Moskva, 14-18 Iyunya 1960. Doklady i Avtoreferaty. Sektsiya II." Moscow, The International Union of Pure and Applied Chemistry, Commission on Macromolecular Chemistry, 1960. 559p. (In French)

It is known that some characteristic features of acrylonitrile, which block polymerization, disappear if the reaction is conducted in the homogeneous phase, and recombination of macroradicals does not take place. A study was made to ascertain whether these features become weaker or disappear on elevating the temperature, at the same initiation rates. The functions of the reaction temperature, the over-all polymerization rate, the relation between the over-all rate and the γ-radiation dose, and the magnitude of the post-effect were investigated. The kinetic results were analyzed in terms of the number of combining radicals present at various temperatures. (auth)

20227

STABILIZATION OF PETROLEUM DISTILLATES. (to Esso Research and Engineering Co.). British Patent 839,552. June 29, 1960.

A method is described for the stabilization of petroleum distillates by subjecting them to high-energy radiation in the presence of an oxygen-containing gas. A method is also reported for determining the stability of petroleum distillates. The method includes fuels for internal combustion engines, heating oils, solvents, lubricating oils, and flushing oils. (W.L.H.)

Raw Materials and Feed Materials

20228 FMPC-255

National Lead Co. of Ohio, Cincinnati.

SUMMARY TECHNICAL REPORT FOR THE PERIOD APRIL 1, 1953 TO JUNE 30, 1953. J. S. Breitenstein, ed. July 15, 1953. Decl. Mar. 7, 1960. 134p. Contract AT(30-1)-1156. OTS.

Progress is reported on the following studies: dissolution and extraction of U from Blockson concentrate, Congo ion-exchange concentrate, and Beaver Lodge U concentrate; extraction characteristics of various foreign ions in the Slurex Process; evaluation of feed materials; development of a pulse column shotgun extraction; feed control system; evaluation of pilot plant extraction runs; pretreatment of organic solvent in the Slurex Process; U scrap processing; degreasing and pickling of U chips; equipment studies; evaluation of metal produced from UF_6; production of U-Zr alloy by coreduction; Mo-U alloys; cleaning and lining furnace pots; melting, casting, and rolling of U; metallographic examination of U; development of routine x-ray techniques for evaluation of preferred orientation; machining U; examination of slugs for surface defects; effect of external heat on reduction of UF_6; removal of UF_4; flow control of UF_6; inspection of Hanford and Savannah River slugs; determination of U in black oxide; determination of Cl, F, Mo, Al, Zr, and metal ion traces in U; determination of U^{+3} in UF_4 and of TBP in aqueous extraction phase; and analysis of dolomite, Li, Mg, and black oxide. (J.S.R.)

20229 K-1437

Oak Ridge Gaseous Diffusion Plant, Tenn.

PROCESS DEVELOPMENTS IN THE MANUFACTURE OF URANIUM HEXAFLUORIDE, JULY 1957–JUNE 1959. July 14, 1960. 41p. Contract W-7405-eng-26. OTS.

Studies made of methods for the manufacture of uranium hexafluoride at the Oak Ridge Gaseous Diffusion Plant between July 1, 1957, and June 30, 1959, are reported. Among the methods and equipment described include the direct fluorination of uranium ore concentrates, purification of uranium hexafluoride by sorption and distillation, a Karbate distillation column for aqueous hydrogen fluoride, and methods for the recovery of uranium and hydrogen fluoride from magnesium fluoride slag generated in the preparation of uranium metal. The results of experiments with laboratory, pilot plant, and plant-scale equipment are presented. (auth)

20230 MCW-1394

Mallinckrodt Chemical Works, St. Louis.

THE PROBLEMS, NATURE, AND CONTROL OF THE ORGANIC CONTAMINATION OF REFINERY LIQUORS. W. G. Bradford, J. A. Kennelley, and G. L. Martin. Decl. Feb. 29, 1960. Mar. 1, 1957. 32p. Contract W-14-108-eng-8. OTS.

A background of data concerning critical organic contaminant concentrations and critical temperatures was developed. These data provided sufficient basis for establishing routine temperature and concentration control where any possibility of this type of reaction could occur. It should be emphasized that the nature of these reactions is such that an empirical approach was the only one justified in point of time and effort. The experimental methods used were those which would give the most meaningful information in the shortest time. A basis for processing sawdust yielding a product which when processed would not exceed the established oil content limits was provided. Due to a fire in the sawdust converter, a decision was made to shut down the unit. This action was taken during the course of the investigation. The laboratory work being done on that phase of the over-all program was terminated with only partial completion of the programed effort in most cases. The information which was gained, however, is presented at this time, because it represents about the only published work done on the problem of oil contaminated sawdust. A possible method of adsorbing oil inadvertently introduced into process liquors from various sources was investigated. (auth)

20231 MCW-1410

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT.

PART I. LABORATORY WORK. Barbara Elliott and John Nelson, eds. Jan. 2, 1958. Decl. May 4, 1960. 108p. Contract W-14-108-eng-8. OTS.

The partial result of a survey of the quantity of HNO_3 insoluble U contained in feed materials is reported. The insoluble contents of lots tested varied from 0.1 to 0.0002% of the U content. Uranium Reduction, Rifle, and Uravan lots contained relatively larger amounts than the Anaconda, Durango, Monticello, Rare Metals, Dawn, and Western Nuclear material tested. Reactions between liquid Na or NaK with hot UO_3 (750°F) or hot UNH (475°F) were found to be violent and extremely exothermic, but in no case was an explosion observed. The reaction between NaK and UNH was most severe of those tested. The phenomenon of "thermal damage" in the hydrofluorination reaction was postulated as due to the sintering of UF_4 under high particle temperatures created from the heat of reaction. The extent to which this effect occurs is believed dependent on the particle temperature and also on the particle size of the oxides involved. The former factor is a function of the intrinsic reactivity of these solids. Evidence was found that indicated that the reflectivity measurements provide an indication of the surface area and/or the particle size of the UO_3. The initial product from the pilot plant fluid-bed denitrator was found to be of low reactivity. Sulfation and grinding improved reactivity somewhat. At 900 to 1000°C, 97% of the water can be removed from 70% HF by the water-gas reaction with contact times of 2 to 10 seconds. This range in contact times is dependent on the type of carbon used. Further investigation will be directed toward the search for a means of carrying out the reaction at lower temperatures either through use of a more active carbon, a catalyst, or a more finely divided carbon. Preparation of crude green salt by dissolution of an ore concentrate in dilute H_2SO_4, filtration, Fe reduction, and precipitation with dilute HF results in appreciable U losses in the residue from the first filtration, and also in the filtrate from the fluoride precipitation. The latter loss can be reduced by precipitation of the double salt, calcium uranous fluoride. The MgF_2 side of the MgF_2–MgO phase diagram was found to contain a simple eutectic. The eutectic composition is about 5.5% MgO and the eutectic temperature, 1224°C. Hydrogen dissolution into molten U was found to be considerably faster from a H_2 atmosphere than from a water atmosphere at the same pressure. This difference in rate apparently becomes greater as pressure of gases is increased from 18 to 470 mm of Hg. Optimum film thicknesses on Mg were found to be formed by reaction with HF in the temperature range 475 to 525°C. When green salt low in water soluble is employed in bombs with filmed Mg, the firing time of the bomb is dependent on the temperature of filming. Crude U yields and the H_2 content of metal were found to improve with extended firing time. Both properties also depend upon the green salt composition. Of the various techniques tested in laboratory scale bombs for the production of low H_2 metal, the most successful to date was the combination of roasted liner, filmed Mg, and He purge. In this manner metal was consistently produced with H_2 contents comparable to those in vacuum recast metal (0.5 ppm). Unfortunately, yields with this technique were less than desirable. Performance testing of the Isotope Ratio Mass Spectrometer is reported. A gamma spectrometric method for the determination of U^{235} in depleted and normal U was developed. Precision of ±0.005 weight percent U^{235} at the 95% confidence limit in normal U was obtained. Further modification of the x-ray spectrographic method for U in raffinate is reported. The dry admixture of internal standard was found advantageous. The indicated precision at the 95% confidence limit is ±3% relative to the concentration of U. (auth)

20232 MCW-1416

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT. PART II. PILOT PLANT WORK. John Nelson, ed. Aug. 1, 1958. Decl. Mar. 30, 1960. 94p. Contract W-14-108-eng-8. OTS.

Based on experimental studies in the pilot plant, a proposal is presented for the use of a pH meter to control automatically the addition of lime in the neutralization of raffinate. Design calculations were made for a continuous pilot-plant fluid-bed reduction reactor of tapering cross-sectional area to handle 50 pounds per hour of fluid-bed-denitrated UO_3. Tests in an eight-inch-diameter screw reactor showed that the uranium content of MFL could be reduced to 0.15–0.20% by treatment with fluorine at elevated temperatures. Evaluations at Bridgeport Brass Company of die materials for gamma extrusion of uranium confirmed that sintered chromium carbide dies attain excellent die life and provide good extruded surfaces. Concave-faced graphite follower blocks have not improved the yield in gamma extrusion when used with flat-faced billets. Studies conducted at Dow Chemical Company of special follower blocks confirm that contour, temperature, and material all require careful selection for achievement of optimum metal yields. Full-sized carbide dies have produced good extruded bar surfaces but require care in butt severance to avoid damage by shear blades. Separation of the butt without need for shears or saw was shown to be feasible by penetrating the butt with a circular punch slightly smaller than the die opening. WAPD-grade UO_2 was ground to an average particle size of 0.8 micron in an eight-inch-diameter Micronizer at production rates between 20 and 50 pounds per hour. Fusion in an atomic hydrogen arc shows promise as a method for growing single crystals of pure UO_2 for fuel element use, employing either UO_2 or UO_3 powders as starting materials. (auth)

20233 MCW-1451

Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.

PROCESS DEVELOPMENT QUARTERLY PROGRESS REPORT FOR APRIL–JUNE 1960. Aug. 1, 1960. 68p. Contract W-14-108-eng-8. OTS.

A recent molybdenum contamination of the refinery product was found to result from highly extractable heteropoly molybdates that form in aqueous feed slurries under certain conditions. These heteropoly molybdates reflux in the primary extraction system, and adequate control is not achieved by maintaining high uranium saturation of the organic extract when the level of reflux becomes too high. Molybdenum control is currently achieved by careful scheduling and blending of aqueous feeds. A pilot-plant flame denitrator designed for continuous operation is described. A correlation was experimentally developed between mill conditions and product particle size for the grinding of fluid-bed-denitrated UO_3. Mixing studies in the tapered pilot-plant reduction fluid-bed show that the equivalent of 13 theoretical countercurrent stages are possible in a single reactor. The pilot-plant tapered-fluid-bed hydrofluorination reactor was modified to improve its operating reliability. The diffusion coefficient for hydrogen in uranium in the 500 to 650°C temperature range is significantly lower for ingot metal than for dingot metal. Grain size does not affect hydrogen diffusion in dingot metal. Diffusion coefficients were used to calculate the time necessary to vacuum outgas uranium cores at various temperatures. (auth)

20234 NLCO-660
National Lead Co. of Ohio, Cincinnati.
SUMMARY TECHNICAL REPORT FOR THE PERIOD OCTOBER 1, 1956 TO DECEMBER 31, 1956. John W. Simmons, ed. Jan. 18, 1957. Decl. Apr. 28, 1960. 159p. Contract AT(30-1)-1156. OTS.

With phosphate complexing, specification product was achieved in Pilot Plant tributyl phosphate extraction of uranium concentrate containing two per cent thorium. Optimum feeding conditions for dehydrating two types of refinery raffinate in the drum dryer were determined, as were calcination conditions for the complete denitration of the dried raffinate. The UO_3 produced at Port Hope Refinery from ammonia-treated uranyl nitrate solution was processed to UF_4 whose AOI content was lower than that of UF_4 produced from normal Port Hope UO_3. Specification green salt was produced from all types of recent Port Hope production orange oxide (UO_3). An over-all conversion of 95 per cent UO_2 was obtained at a 500-pound-per-hour UO_3 feed rate during 44 hours of Moving Bed Reactor operation. Greater than 90 per cent conversion to UF_4 was obtained over a period of eight hours in a hydrofluorination run. (This series of tests is not yet complete.) It was determined that a linear relationship exists between the time required for reduction of UO_3 to UO_2 and the UO_3 surface area. Samples of the UF_4 produced by the Excer process were reduced in laboratory-scale apparatus. In an investigation of normal UF_4–Mg reduction charges, it was shown that the production of $11\frac{1}{2}$-inch-diameter briquettes of UF_4–Mg is feasible and that high reduction yields are realized in production-scale equipment. The process variables and operating conditions for the continuous reduction-to-metal process were studied. The results indicate that roll briquettes are a feasible charge material, that a preheat temperature of 2750°F is necessary, and that close temperature control is required for continuous pouring of the molten products. A 7-inch ingot having a uniform isotope content was produced by melting derbies of various enrichments and casting the molten metal after a brief holding period. A drill of correct design for precision-drilling of production type slugs was found. In a study of grain refinement of cast slugs, the grain size obtained after a single beta heat treatment was found to be inversely related to the impurity content. Delay time between bath and quench was also thought to be an important factor affecting grain size. In work involving many samples from five production rods, it was found that the slug yield was inversely related to the total area of massive hydride stringers. (auth)

20235 NP-8867
Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.
MONTHLY REPORT DEVELOPMENT FOR MAY 1960. 17p. (D-60-5).

Results of leach tests on Beaverlodge March mill head are tabulated. Results indicate that in a nitrogen atmosphere and under ambient temperature, a final barren of 0.01 g/l U_3O_8 can be obtained from a starting barren of 0.07 g/l U_3O_8 after contact times of 2 minutes. Production of uranium dingots by reduction with activated carbon is reported in which part of the dingots were air cooled or held at 1044°F for one hour. Diagrams showing locations and amounts of included carbon are shown. Results of ADU ammonia precipitation studies with relation to sintered densities are presented. These data indicate that a UNH solution of 140 g/l be used if greater than present throughput is required. Continuous ADU production in a rotary kiln was tested with the objective of obtaining uniform size pellets. Characteristics of these pellets are described. The effects of hydrogen dilution on sintered density were studied. Results of the study indicate that under optimized conditions of pretreatment and reduction batches of ADU yield a product which will sinter to a density of 10.7 g/cc. Data on effects of reduction temperature on sintered and density are included along with information on effects of re-oxidation on sintered density. (For preceding period see NP-8738.) (J.R.D.)

20236 NYO-1339
Mallinckrodt Chemical Works, St. Louis.
URANIUM METAL BY BOMB REDUCTION. VI. IGNITION TEMPERATURES OF MAGNESIUM METAL WITH UF_4, UO_2F_2, UO_2, U_3O_8, and UO_3. J. W. Stevenson and A. E. Ruehle. Jan. 31, 1953. Decl. Mar. 7, 1960. 41p. Contract W-14-108-eng-8. OTS.

The metal yield in production bombs was known to be grossly affected by the rate at which the bombs are heated to the firing temperature. It is now found that the ignition temperature of small charges of UF_4 and Mg is likewise affected by the heating rate. This is attributed to the formation of films on the surface of the Mg particles, which control the rate of reaction between UF_4 and Mg metal at elevated temperature. Some of the factors which affect the properties of these films were studied, and means of controlling their production are suggested. (For preceding report in series see NYO-1335.) (auth)

20237 NYO-1353
Mallinckrodt Chemical Works, St. Louis.
PROCESS DEVELOPMENT QUARTERLY REPORT, PART I. W. M. Leaders and E. I. Miller. Apr. 15, 1953. Decl. Mar. 7, 1960. 158p. Contract W-14-108-eng-8. OTS.

Progress is reported on the following studies: ether extraction with a 4-in. jet mixer column, filtration of the MgX slurry (a U-bearing feed material prepared by $Mg(OH)_2$ precipitation of a filtrate from a H_2SO_4 leach of low-grade pitchblende ores), U recovery from metal turnings, U metal by bomb reduction, casting of U, continuous denitration of $UO_2(NO_3)_2 \cdot 6H_2O$, MgX filtration and extraction column scale, UO_3 processing with higher than normal B content, effect of UO_2F_2 concentration in UF_4 on U yields, effect of derby conditioning on ingot quality, plant yields with impregnated crucibles, effect of mold dressing on metal quality, ingot mold design, and production of U–Zr alloys. (For preceding report see NYO-1352.) (L.T.W.)

20238 NYO-1358
Mallinckrodt Chemical Works, St. Louis.
PROCESS DEVELOPMENT QUARTERLY REPORT, PART II. W. M. Leaders and E. I. Miller. Oct. 15, 1953. Decl. Mar. 15, 1960. 110p. Contract W-14-108-eng-8. OTS.

Progress of the work is reported on ether extraction of $UO_2(NO_3)_2$ using a 4-in. jet-mixer column, pilot-plant studies of the wax complex (Waxco) extraction process, production of U metal by bomb reduction, pilot-plant casting of U metal, production of U-Zr, Mo-U, and W-U alloys, and the extraction of U_3O_8 slurry salted with Ca and Mg. (J.E.D.)

20239 TID-10111
National Lead Co. of Ohio, Cincinnati.
SUMMARY TECHNICAL REPORT FOR THE PERIOD OCTOBER 1, 1954 TO DECEMBER 31, 1954. J. W. Simmons, ed. Jan. 15, 1955. Decl. Mar. 31, 1960. 205p. Contract AT(30-1)-1156. OTS.

The progress of the work covered the laboratory evaluation of TBP extraction flowsheet, Ohmart density measurements, corrosion studies, denitration-acid recovery, green salt and hexafluoride reduction processes, reduction of

UF_6, production tests of a thermocouple unit, developments in the production of U–Zr alloys, and preparation of 5% Mo–U alloys, γ-extruded U tubes, scrap recovery, refining of Brazilian sludge for the Th, ThF_4 production process, U contamination of Th oxalate precipitation, slug casting, determination of ammonium oxalate insoluble in green salt and wet chemical, spectrochemical, and process control in the analytical department. (W.L.H.)

20240

RECENT ADVANCES IN THE PREPARATION OF SINTERABLE URANIUM DIOXIDE. G. Imárisio (Centro Informazioni Studi Esperienze, Milan). Energia nucleare (Milan) 7, 470-6(1960) July. (In Italian)

Recent advances in the preparation of sinterable uranium dioxide are examined. The influence of different experimental conditions on the quality of the UO_2 obtained and on the sintered density is evaluated. The need for further researches in order to attain a full understanding about the sintering mechanism and to obtain more constant sizes of the sintered pellets is pointed out. (auth)

20241

MANUFACTURE OF URANIUM TETRACHLORIDE. Sam Rosenfeld. British Patent 841,681. July 20, 1960.

A method is described for the preparation of UCl_4 by the reaction of uranium oxide with carbon tetrachloride vapor at elevated temperature. (W.L.H.)

Separation Processes

20242 CF-52-7-163

Oak Ridge National Lab., Tenn.

RECOVERY OF URANIUM FROM PUREX IEU. Progress Report. E. M. Sampson, Jr. July 29, 1952. Decl. Mar. 23, 1960. 15p. Contract [W-7405-eng-26]. OTS.

Uranyl nitrate product from the ORNL Purex pilot plant was shipped to the Mallinckrodt Chemical Works for evaluation in the denitration step. Some of the resulting orange oxide was retained for evaluation in the steps leading to metal production. The rest of the UO_3 was shipped to K-25 for a study of Purex material in the production of UF_6. The information obtained on the behavior of the Purex U during processing at the two locations is summarized. The performance of Purex U is compared to that obtained with Mallinckrodt of Harshaw material. (L.T.W.)

20243 CF-60-3-161

Oak Ridge National Lab., Tenn.

HRT-CHEMICAL PLANT RUNS 18 AND 19 SUMMARY. O. O. Yarbro. Mar. 25, 1960. 22p. Contract [W-7405-eng-26]. OTS.

Prior to run 18 the chemical plant take-off was relocated in an attempt to remove solids directly from the vicinity of the reactor core wall by means of a tube inserted through the core access flange and connected to the hydroclone feed line. The chemical plant hydroclone loop was operated 1070 hours with this new intake during reactor runs 18 and 19, and removed 1105 g of corrosion product solids. The composition of the corrosion product solids averaged 41% zirconium, 23% iron, 7% chromium, and 0.7% titanium, which was similar to that observed during run 17. The ratio of uranium and copper to total corrosion products averaged 0.062 and 0.015, respectively, in solids collected during runs 18 and 19. In this period stainless steel corrosion products removed exceeded by a factor of three the corrosion products produced, calculated from nickel build-up in reactor fuel. Zirconium corrosion was less than 10 mpy, the minimum rate detectable from data obtained in these runs. Fission products concentrated by the chemical plant included zirconium, ruthenium, tellurium, yttrium, neodymium, and iodine. The total corrosion product solids inventory in the reactor system at the end of run 19, based on solids composition data, was estimated to be approximately 16 kg in the core and 8 kg in the blanket system. (auth)

20244 DP-82

Du Pont de Nemours (E. I.) & Co. Explosives Dept., Wilmington, Del.

OPERATION OF TNX EVAPORATOR. G. S. Nichols and E. S. Occhipinti. Oct. 1954. Decl. Apr. 21, 1960. 27p. Contract AT(07-2)-1. OTS.

Performance data were obtained for the TNX replacement evaporator when operated within the limits imposed by a new control system. This system was designed to avoid conditions which might lead to a repetition of an earlier explosion due to inclusion of organic material in the uranyl nitrate–nitric acid system, which was heated to elevated temperature. The true heat transfer coefficient was found for all concentrations of solutions to be evaporated in the plant and will allow operation at design capacities. (auth)

20245 ERI-2240-4-F

Michigan. Univ., Ann Arbor. Engineering Research Inst.

STUDY OF THE FEASIBILITY OF AQUEOUS RECOVERY OF SPENT FUELS. PART 4. EQUIPMENT DESIGN DATA. R. J. Annesser, R. J. Hennig, J. G. Lewis, and H. A. Ohlgren. July 1954. Decl. Mar. 28, 1960. 298p. (HAO-24). OTS.

Work done for Dow Chemical-Detroit Edison and Associates, Atomic-Power Development Project at request of Consumers Power Co. (Jackson County).

Results of preliminary engineering performed on the design of an aqueous recovery and metals conversion plant for spent irradiated fuel elements from the proposed Dow Chemical-Detroit Edison and Associates nuclear power breeder are presented. Process design work was done to determine the order of magnitude of capital and operating costs of an optimum recovery plant, including all equipment, installation, and buildings. Preliminary equipment specifications for all components are given. (W.L.H.)

20246 HW-18407

Hanford Works, Richland, Wash.

PREPARATION AND PROPERTIES OF RAF SOLUTIONS; LOW ACID TBP FLOWSHEETS HW NUMBER 4 AND HW NUMBER 5. R. F. Maness and M. K. Harmon. July 25, 1950. Decl. Mar. 28, 1960. 12p. Contract W-31-109-Eng-52. OTS.

The laboratory preparation of RAF solutions using minimum amounts of nitric acid was investigated, and the solubility versus time relationships of these solutions were observed. Increasing or decreasing both the uranium molarity and the acid concentration in the same proportion gave a series of points roughly parallel to the phase boundary for saturation with respect to uranyl phosphate. The parameter of time gave an additional parallel series, with the period of stability of the resulting solutions decreasing in proportion to the decrease in acidity. Temperature appeared to have no appreciable effect on the stability. From the data obtained, it was demonstrated that a low-acid feed stream with a $U:PO_4$ mole ratio of 0.8 to 1.0 is adequately stable and would permit a reduction in nitric acid consumption compared to RAF preparation per TBP Flowsheet HW No. 3. It was also determined that concentration following dissolution results in moving the system toward the stable region with respect to the precipitation of uranium phos-

phate salts and that solid-phase formation during evaporation will not occur due to the formation of retrograde soluble salts. (W.L.H.)

20247 HW-18414

Hanford Works, Richland, Wash.

NITRIC ACID DISSOLUTION OF URANIUM–ALUMINUM ALLOY. R. E. Burns and C. H. Holm. Aug. 12, 1952. Decl. Mar. 28, 1960. 19p. Contract W-31-109-Eng-52. OTS.

Hg-catalyzed HNO_3 dissolution of U-Al alloys was studied in an attempt to find the optimum conditions to effect dissolution in minimum time. It was found that, for any given concentration of $Al(NO_3)_3$ in the solution, there exists a corresponding concentration of HNO_3 for which the dissolving rate is a maximum. Curves are presented showing the variation of dissolving rate with HNO_3 concentration at given $Al(NO_3)_3$ concentrations. Experiments with a continuous column-type dissolver showed that, while chemically feasible, practical application of the process would require solution of many problems such as excessive foaming, apparent preferential dissolution of Al, continuous feed of alloy elements to the column and plugging at the bottom of the column by small pieces of undissolved metal. (auth)

20248 HW-20281

Hanford Works, Richland, Wash.

PUREX PULSE-COLUMN STUDIES WITH UNIRRADIATED URANIUM. (Development of Specifications for the O.R.N.L. Pilot Plant). J. G. Bradley. Feb. 20, 1951. Decl. Mar. 28, 1960. 12p. OTS.

To obtain operating and performance data using pulse columns to process purex-type feeds, a series of IA simple extraction and IC column studies were carried out in the Demonstration Unit, 3-in.-ID pulse column, and tentative ORNL pilot-plant IA-IB-IC cascade pulse-column battery specifications were developed. The data obtained from the purex runs are summarized, and the pilot-plant specifications estimated from these runs are presented. (W.L.H.)

20249 HW-20580

Hanford Works, Richland, Wash.

KINETICS OF PLUTONIUM REDUCTION IN THE REDOX 1B COLUMN. Robert Lee Moore. Mar. 20, 1951. Decl. Mar. 28, 1960. 10p. Contract W-31-109-eng-52. OTS.

Spectrophotometric studies revealed no detectable slowness in the rate of reduction of Pu(VI) to Pu(III) by ferrous sulfamate in hexone-saturated aqueous 1B solutions. No absorption attributable to Pu(V) was found. Two-phase studies were also made in which a hexone phase containing Pu(VI) was contacted with an aqueous 1B solution containing ferrous sulfamate. The results indicate that the reduction of Pu(VI) to Pu(III) under column 1B conditions is essentially instantaneous, but that there may be some slowness in either the diffusion process or in the rate of transfer across the hexone-aqueous interface. (W.L.H.)

20250 HW-22076

Hanford Works, Richland, Wash.

LABORATORY DEMONSTRATION OF REDOX FEED HEAD-END TREATMENT; RUTHENIUM VOLATILIZATION AND MANGANESE DIOXIDE SCAVENGING. H. G. Hicks, C. G. McCormack, and W. E. Roake. July 15, 1951. Decl. Mar. 28, 1960. 61p. Contract W-31-109-Eng-52. OTS.

The prime motive behind the experiments described in this report is the desire to reduce the number of Redox cycles necessary for decontamination from fission products of the plutonium and uranium streams sufficient to allow final disposition of these two products. This report deals with the mechanics of manganese dioxide handling, laboratory development of manganese dioxide scavenging, and a series of experiments at multicurie level combining Ru volatilization and MnO_2 scavenging in stainless steel equipment. Of particular interest in these last mentioned studies were the rate and extent of Ru volatilization as functions of the composition of sparge gas and oxidant, the rate of volatilized Ru as a function of sparge gas composition, and the decontamination from Zr and Nb as functions of concentration and method of formation of the MnO_2 scavenger. (W.L.H.)

20251 HW-64010

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DAREX PILOT PLANT STUDIES. J. J. Shefcik. Feb. 12, 1960. 37p. Contract AT(45-1)-1350. OTS.

Darex pilot plant studies revealed that stainless steel-clad U or UO_2 fuel elements can be dissolved completely and smoothly with aqua regia in a batch dissolver. The factors affecting the composition of the dissolvent are discussed. Sintered UO_2 dissolved readily in aqua regia, the UO_2 porosity being a prime factor in the rate of dissolution. Metallic U dissolved more rapidly in aqua regia than in nitric acid. An increase in U concentration or NO_3^- to Cl^- ratio decreased the reaction rate. Chloride removal from the dissolver solution was affected by oxidation and/or volatilization. Excess HNO_3 is removed from chloride-free dissolver by concentration, by continuous water addition and boil-off, or by destruction with formaldehyde. Corrosion to materials of the pilot plant is discussed. (C.J.G.)

20252 IDO-14419

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

IDAHO CHEMICAL PROCESSING PLANT TECHNICAL PROGRESS REPORT FOR APRIL THROUGH JUNE 1957. C. E. Stevenson. Sept. 25, 1957. Decl. May 4, 1960. 75p. Contract AT(10-1)-205. OTS.

Aluminum Alloy Fuel Process Studies. Tests of cutting and flattening irradiated tubular Al alloy fuel pieces were undertaken to determine the feasibility of carrying out this operation in the fuel cutting facility. Additional studies were carried out to compare the rate of continuous dissolution of Al in the form of rods, tubes, plates and flattened tubes. The mechanism of Hg catalysis of Al dissolution in HNO_3 was further developed by studies of the oxidation of Hg by HNO_3. Development of Fluid Bed Waste Calcining Process. Laboratory and pilot plant development of a process for the conversion of high activity $Al(NO_3)_3$ extraction process wastes to a storeable solid form (alumina) was continued. The conversion is accomplished by decomposition of nitrates in a fluidized bed of Al_2O_3. Venturi and packed scrubbers and cyclones were studied for particle removal from calciner off-gas. Studies were made of the leaching of fission products from calcined Al_2O_3 by dilute HNO_3, and the density thermal conductivity, and reactivity with water of Al_2O_3 were determined. The distribution of fission product Ru was also determined. Tests of Pumps and Other Equipment for Process Applications. Tests were continued to develop applications and reliability of canned rotor and other types of pumps. Evaluation of flowmeters was continued. Development of an Acid Monitoring Instrument for TBP Process Feed Streams. A miniature high-frequency oscillator for the determination of high concentrations of HNO_3 and $Al(NO_3)_3$ in aqueous solutions was developed and is being evaluated. Reduction of Iodine During RaLa Processing. Radioactive Iodine released from an MTR element during the isolation of Ba^{140} in the RaLa Process was difficult to confine either as a liquid waste or as a gaseous waste. Operations

Evaluation Studies. Methods were devised to aid in determining the reliability of I_2 measurements in caustic scrubber solutions and of NH_3 concentrations in HNO_3 solutions. Experimental designs were prepared for evaluating catalytic effects in Al dissolution, optimum conditions for laboratory extractions, and variables in fluid bed decomposition of $Al(NO_3)3$. Analytical Methods Development. In the development of analytical methods a method for the separation of U by liquid-liquid extraction, spectrophotometric determination of U, determination of NO_2^-, and determination of B in Al alloy fuels are presented. (For preceding period see IDO-14410.) (W.L.H.)

20253 IDO-14501

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

IDAHO CHEMICAL PROCESSING PLANT TRIBUTYL PHOSPHATE EXTRACTION OF URANIUM FROM AMMONIUM NITRATE SOLUTIONS. R. A. Kent and K. L. Rohde. July 22, 1960. 14p. Contract AT(10-1)-205. OTS.

The uranium distribution data required for the ammonium nitrate salted feed resulting from the ammonium fluoride dissolution-barium fluozirconate head-end flowsheet for STR-type fuel were obtained with 5, 10, and 20% tributyl phosphate. The results showed that ammonium nitrate is an adequate salting agent. Nitric acid inhibited the extraction slightly, but small amounts of fluoride ion interfered seriously. (auth)

20254 IDO-14509

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

IDAHO CHEMICAL PROCESSING PLANT TECHNICAL PROGRESS REPORT FOR JULY THROUGH SEPTEMBER 1959. C. E. Stevenson. June 12, 1960. 91p. Contract AT(10-1)-205. OTS.

Dissolving of stainless steel fuels in H_2SO_4 and their first cycle TBP extraction were carried out satisfactorily in initial hot operation of SIR process equipment. A measurement of the heat generation rate from a tank of high-activity Al process waste less than six months old yielded a value of about 2.5 Btu/hr/lb Al_2O_3. A potentially attractive modification of the hydrofluoric acid process for dissolving Zr fuels which was developed involves the precipitation of barium fluozirconate from the dissolver product solution. It was found possible to dissolve Zr alloys electrolytically in a methanol-HCl mixture with a minimum of sludge formation by operating at current densities over 1.2 amps/sq cm. A fused chloride salt process continued to look promising for the treatment of Zr and other fuel alloys. Butyl nitrate was found to be an important degradation product of TBP in contact with nitric acid. The characteristics of air lifts for low flow volumes were extensively tested. Process studies in the development of an $Al(NO_3)_3$ waste calcining process are given. Analytical methods were developed for lead, for radioactive metals, and for aqua regia process off-gas components. (For preceding period see IDO-14494.) (W.L.H.)

20255 IDO-14512

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

IDAHO CHEMICAL PROCESSING PLANT TECHNICAL PROGRESS REPORT, OCTOBER-DECEMBER 1959. John R. Bower, Jr., ed. May 26, 1960. 85p. Contract AT(10-1)-225. OTS.

The ICPP successfully processed an experimental core of OMRE fuel on a modified stainless steel dissolution flowsheet, achieving 99.63% recovery through the first cycle. Laboratory studies on aqueous Zr fuel processing indicated that increased U capacity together with lower waste storage requirements could be achieved with the present process if a system of short-term stability could be tolerated. Successful dissolution of Zircaloy-2 with 3% U was achieved under various conditions of air sparging and hydrogen peroxide addition using the Zirflex process. Aqueous stainless steel processing studies, carried out in conjunction with OMRE fuel recovery, disclosed that a surface film on the elements which was resistant to sulfuric acid, sodium hydroxide, hydrogen peroxide, and hydrocarbon solvents could be removed in boiling Turco 4502 solution. Cesium-137 was removed from acidic radioactive wastes containing gross amounts of Al or Zr by use of an inorganic ion exchange capacity of ~0.2 g of cesium per g of APM. In a study of solvent stability, the rate of formation of n-butyl nitrate in TBP, as a result of contact with various concentrations of HNO_3, was determined to be a function of the extracted acid concentration, and to be accelerated by the presence of Zr in the organic phase. Preliminary investigation of electrolytic dissolution of stainless steel in HNO_3 suggests flowsheet conditions which might give a metal concentration as high as 150 g/liter in 1M acid, resulting in low column feed rates, low raffinate bulk, and very favorable U distribution conditions with low percentages of TBP. Since the electrolytic dissolution of Zr type fuel appears feasible in HCl-methanol, extraction of U from this solvent was studied. A corrosion evaluation program has indicated excellent resistance of 30% Ir-70% Pt alloy to boiling mixtures of $HF-HNO_3$, $HCl-HNO_3$, and $H_2SO_4-HNO_3$ in ranges most likely to be considered for fuel element dissolutions. (For preceding period see IDO-14509.) (W.L.H.)

20256 ORNL-2183

Oak Ridge National Lab., Tenn.

DISSOLUTION OF URANIUM–ZIRCONIUM FUEL ELEMENTS IN FUSED $NaF-ZrF_4$. R. G. Wymer. Feb. 11, 1957. Decl. Mar. 28, 1960. 29p. Contract W-7405-eng-26. OTS.

Experiments confirmed the suitability of $NaF-ZrF_4$ as a solvent for Zr–U fuel elements. A preliminary dissolution flowsheet, as a basis for a fused salt-fluoride volatility process, is presented. (auth)

20257 ORNL-2952

Oak Ridge National Lab., Tenn.

RECOVERY OF URANIUM FROM DI(2-ETHYLHEXYL) PHOSPHORIC ACID (DAPEX) EXTRACTANT WITH AMMONIUM CARBONATE. F. J. Hurst and D. J. Crouse. July 14, 1960. 19p. Contract W-7405-eng-26. OTS.

A process was developed through bench-scale for recovering uranium from di(2-ethylhexyl) phosphoric acid-kerosene (Dapex) extractant with ammonium carbonate solution. The solvent is modified with diamyl amylphosphonate to enhance uranium extraction and to prevent separation of the ammonium di(2-ethylhexyl) phosphate from the kerosene diluent during stripping. The ammonium carbonate concentration is maintained at 0.9 to 1.6 M, and the strip solution is recycled in order to precipitate ammonium uranyl tricarbonate (AUT) in the stripping system. The crystalline AUT settles and filters rapidly and is readily converted to U_3O_8 by calcination at 300 to 500°C. In continuous tests, complete stripping of uranium and contaminants and favorable physical operation were obtained over a wide range of recycle solution composition. Excellent separation of uranium from extracted molybdenum and partial separation from extracted vanadium occurred in the precipitation step. (auth)

20258 RDA-DC-4

Vitro Corp. of America, New York.

PROPOSED "PUREX" SEPARATIONS PLANT. STUDY "A;" JOB 15. Apr. 15, 1952. Decl. June 7, 1960. 67p. OTS.

The feasibility and the operating, maintenance, and construction characteristics of an open type of canyon design eliminating the conventional concrete cell type of construction now used in separation facilities at the Hanford Works are discussed. Seven different building arrangements are presented and are compared on the basis of building volume, concrete volume, and floor space. (W.L.H.)

20259

THE CATION SIEVE PROPERTIES OF CLINOPTILOLITE. L. L. Ames, Jr. (General Electric Co., Richland, Wash.). Am. Mineralogist 45, 689-700(1960) May-June.

A zeolite was sought for use in columns that would selectively remove Cs from solutions containing large concentrations of competing cations. Clinoptilolite was found to be highly Cs-selective over wide pH, flow rate, and temperature ranges. Factors affecting clinoptilolite cation selectivities included cation size, charge, electronic structure, and, in the presence of Na, temperature. (auth)

20260

LIQUID-LIQUID EXTRACTION OF URANIUM AND PLUTONIUM FROM ACETATE SOLUTION WITH TRIISOOCTYLAMINE. SEPARATION FROM THORIUM AND FISSION PRODUCTS. F. L. Moore (Oak Ridge National Lab., Tenn.). Anal. Chem. 32, 1075-9(1960) Aug.

A new and rapid method for the liquid-liquid extraction of uranium and plutonium from acetate solution is based on the use of triisooctylamine dissolved in xylene or other organic solvents. Uranium and/or plutonium are separated from thorium, alkalies, alkaline earths, rare earths, zirconium, niobium, ruthenium, iron, protactinium, americium, and other elements which do not form anionic species under the conditions described. The technique may be used for either tracer or macro quantities of uranium. Several practical applications of the method in radiochemical analysis and purifications are proposed. (auth)

20261

SEPARATION OF URANIUM AND PROTACTINIUM FROM THORIUM BY AMINE EXTRACTION. Fujio Ichikawa and Shinobu Uruno (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan 33, 569-75(1960) May. (In English)

The extraction of thorium, protactinium, and uranium from HCl, H_2SO_4, and HNO_3 of various concentrations with a secondary amine was studied. Amberlite LA-1 in kerosene diluent was used as the extractant. The maximum extraction coefficient for uranium in HCl was about 200, in HNO_3 2 to 5, and in H_2SO_4 1 to 3. Thorium was not extracted from these acids except in 6 to 15N HNO_3, but even then the extraction coefficient was only 0.5. For protactinium the maximum extraction coefficient was 60 for HCl. The extraction coefficients for HNO_3 and H_2SO_4 were very low. The selectivity for uranium shown in these results indicated a method for separation of uranium from protactinium and thorium. The effects of radiation on Amberlite LA-1 and LA-2 under the total dose of 5×10^7 r were negligible. (M.C.G.)

20262

INORGANIC EXTRACTION STUDIES ON THE SYSTEM BETWEEN TRI-n-BUTYL PHOSPHATE AND HYDROCHLORIC ACID. Tomitaro Ishimori, Kenju Watanabe, and Eiko Nakamura (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan 33, 636-44(1960) May. (In English)

Solvent extraction behavior of forty-eight elements from sodium to cerium in the tributyl phosphate–hydrochloric acid system was studied. The results are summarized in a series of graphs and tables. (M.C.G.)

20263

COPRECIPITATION OF NEPTUNIUM WITH LANTHANUM TRIFLUORIDE. Eiko Nakamura (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan 33, 702-4 (1960) May. (In English)

The different coprecipitation behaviors of neptunium(IV), (V), and (VI) were studied with the aid of tracers. The oxidation state of the neptunium tracer used was determined by solvent extraction behavior and coprecipitation behavior with lanthanum trifluoride and zirconium phosphate. Only neptunium(IV) was extracted by TTA and was carried down by zirconium phosphate. Neptunium(IV) coprecipitated with lanthanum trifluoride in HNO_3 and HCl solutions. In a series of experiments on Np(V) and (VI) the distribution ratios were measured between mineral acid and 100% TBP. Zirconium phosphate did not carry them down quantitatively. Neptunium(V) was carried down with LaF_3 but neptunium(VI) was not. (M.C.G.)

20264

PULSED COLUMNS IN LIQUID-LIQUID EXTRACTION. PART II. DESIGN. L. Damiani, A. Doria, and V. Fattore (Sicedison S.p.A., Porto Marghera, Italy). Energia nucleare (Milan) 7, 463-9(1960) July. (In Italian)

Some methods are described for designing pulsed columns. The determination of column height, diameter, and power required for pulse generation is dealt with. (auth)

20265

CHEMICAL PROCESSING OF YTTRIUM SCRAP. Douglas M. Provow and Ray W. Fisher (Ames Lab., Ames, Iowa). Ind. Eng. Chem. 52, 681-2(1960) Aug.

A chemical process was developed for the economical purification and conversion of yttrium scrap to a material that could be used in the production of very pure metal. Special emphasis was given to the removal of impurities which would otherwise build up in metal production. The scrap was first burned on an open fireplace and then in silica trays at 800°C to form crude yttrium oxide. The oxide was dissolved in a 50% HNO_3 solution, steam added, and zirconium, iron, aluminum, and titanium impurities were precipitated as hydroxides. Potassium ferrocyanide was added to remove copper and nickel. The yttrium was then precipitated with oxalic acid. The oxalate was converted to the oxide by heating on silica trays at 800°C. (M.C.G.)

20266

MECHANISM OF THE EXTRACTION OF URANIUM(VI) BY TRIBUTYLPHOSPHATE (TBP) FROM HCl SOLUTIONS. V. B. Shevchenko, I. G. Slepchenko, V. S. Shmidt, and E. A. Nenarokomov. Zhur. Neorg. Khim. 5, 1095-9(1960) May. (In Russian)

Varying concentrations of TBP in CCl_4 were contacted with a large volume of saturated uranyl chloride solution in contact with solid salt. Analyses of the organic phase showed that the ratio of TBP to uranium(VI) to chloride was approximately 2:1:2 corresponding to $UO_2Cl_2 \cdot 2$ TBP. The chloride content in the organic phase was determined in the presence and absence of uranium after contacting with an aqueous phase containing 3.0 to 7.6 N HCl. It was found that the ratio of chlorine associated with the uranium to total uranium in the organic phase was approximately two irrespective of the concentration of HCl in the aqueous

phase. Thus, U(VI) is extracted by 20% TBP not as a complex acid but as the compound UO_2Cl_2 with TBP. Distribution coefficients for uranyl chloride were determined from 4.6, 5.9, and 7.6 N HCl with a variable concentration of TBP in CCl_4. A plot of the log of the distribution coefficients versus the log of the concentration of free TBP gave three straight lines each of which had a slope of two. Thus it is shown that there are two molecules of TBP in the uranyl chloride complex $UO_2Cl_2 \cdot 2$ TBP. The extraction coefficients of uranyl chloride by 20% TBP in CCl_4 are very small at <3 N HCl, rise to a maximum of 56 at 8.0 N HCl and then fall somewhat at higher concentrations of HCl. (TTT)

20267

EXTRACTION OF PERCHLORIC ACID BY TRIBUTYLPHOSPHATE (TBP). V. V. Fomin and E. P. Maiorova. Zhur. Neorg. Khim. 5, 1100-6(1960) May. (In Russian)

In studying hydrolysis, complex formation, polymerization, etc., by solvent extraction, it is necessary to know the behavior of $HClO_4$ which is often added to the system to maintain constant ionic strength. A plot of the log of concentration of $HClO_4$ in the organic phase versus log of the concentration of $HClO_4$ in the aqueous phase gave a straight line with a slope of one at low concentrations of $HClO_4$ as predicted by theory. The slope of one indicates that the compound formed with TBP contains only one molecule of $HClO_4$. No complex is formed by association. On comparing the relative concentrations of $HClO_4$ in the organic phase at 0.5, 1.0, 1.5, 2.0, and 2.5 mol/l of TBP in benzene, it was established that $HClO_4$ is extracted as $HClO_4 \cdot 4$ TBP at lower concentrations of $HClO_4$ and as $2\ HClO_4 \cdot 4$ TBP at higher concentrations of $HClO_4$. The formation constant K_1 for $HClO_4 \cdot 4$ TBP was equal to 0.16 as an average. (TTT)

20268

EXTRACTION OF WATER BY THE DIISOAMYL ETHER OF METHYL PHOSPHORIC ACID (DAMP). A. S. Solovkin. Zhur. Neorg. Khim. 5, 1107-11(1960) May. (In Russian)

DAMP is resistant to attack by 2% $KMnO_4$ or $K_2Cr_2O_7$ in 2.0 N HNO_3 at room temperature, and even 18 N HNO_3 does not affect the extractive ability of this reagent. DAMP can be successfully used along with TBP in practice. The solubility of water in 100% DAMP (7.2 mol H_2O/l) is twice that of TBP, but the solubility of water falls off rapidly on the addition of a non-polar organic diluent in the following order: the solubility of water in the organic diluent isoamyl acetate > dibutyl ether > benzene > kerosene > CCl_4. The effect of the diluent on the solubility of water in the organic phase is less noticeable at high concentrations of DAMP. The solubility of water in DAMP decreases with increasing content of uranyl nitrate in the organic phase due to the formation of the anhydrous complex $UO_2(NO_3)_2 \cdot 2$ DAMP. It was found that up to 30 vol % DAMP, water is extracted into the organic phase as the monosolvate DAMP $\cdot H_2O$, while at 30 to 100 vol % DAMP the composition of the complex corresponds to the formula DAMP $\cdot 2H_2O$. It was possible to identify these aqueous solvates spectrophotometrically. (TTT)

20269

EXTRACTION OF NITRIC ACID, PERCHLORIC ACID AND URANYL NITRATE BY TRIBUTYLPHOSPHATE (TBP) SOLUTIONS AT ISOMOLAR CONCENTRATIONS. V. V. Fomin, R. E. Kaptushova, and E. P. Maiorova. Zhur. Neorg. Khim. 5, 1337-44(1960) June. (In Russian)

An attempt was made to determine the composition of the nitric acid, perchloric acid, and uranyl nitrate complexes with TBP by contacting equal volumes of TBP in benzene with a HNO_3 or $HClO_4$ solution. The acid in both phases is titrated with caustic. The sum of the initial concentration of TBP in benzene and of the acid in the aqueous was held constant. A plot of the initial concentration of acid in the aqueous phase versus the concentration of acid in the aqueous phase after equilibration showed a maximum in the acid concentration in the organic phase at a ratio of initial TBP to initial acid concentration in the aqueous equal to one. This evidence constitutes proof of the formation of $HNO_3 \cdot$ TBP in the organic phase. In a similar fashion it is shown that the perchloric acid complex is $HClO_4 \cdot 2$ TBP. It was necessary to use activities for concentrated uranyl nitrate solution to obtain the composition of the uranyl complex which was found to be $UO_2(NO_3)_2 \cdot$ 2 TBP. The sum of the initial concentrations of uranyl nitrate and TBP were held constant at 2.25 molar. (TTT)

20270

EXTRACTION OF NITRIC ACID BY THE DIISOAMYL ETHER OF METHYL PHOSPHORIC ACID (DAMP). A. S. Solovkin. Zhur. Neorg. Khim. 5, 1345-57(1960) June. (In Russian)

The degree of hydration of organic complexes in an organic solvent is important in understanding solvent extraction mechanisms. On contacting 100% DAMP or a 30 vol % DAMP solution of CCl_4 with 0.4 to 16.1 N HNO_3 solutions, it was found that at first the content of water in the organic phase rises sharply with increasing acidity, passes through a maximum, and then decreases. At high concentrations of HNO_3 (>10 N) the water content in the organic phase again rises significantly. From absorption spectra and analyses for water in the organic phase, it was found that at a concentration of 0.37 to 1.43 N HNO_3 in the organic phase the complex is primarily the trihydrate $HNO_3 \cdot 3H_2O \cdot$ DAMP; up to 2.82 N HNO_3 in the organic phase, there is a mixture of the trihydrate and the monohydrate. At 3.62 N HNO_3 in the organic phase the predominant form is the monohydrate $HNO_3 \cdot H_2O \cdot$ DAMP. At a high concentration of 4.85 N HNO_3 in the organic phase, the hemihydrate $HNO_3 \cdot 0.5H_2O \cdot$ DAMP is formed. A plot of the log of the distribution coefficient for HNO_3 versus the log of the concentration of DAMP in the solvent at an ionic strength of 1 and 3 in the aqueous phase showed that the ratio of HNO_3 to DAMP in the extracted complex = 1. At >5 N HNO_3 in the aqueous phase, a dissolvent in which the ratio of HNO_3 to DAMP = 2 is extracted in significant quantities. At 16.1 N HNO_3 the solubility of DAMP in HNO_3 was found to be 53.8 g/l. On agitating DAMP or tributylphosphate (TBP) with 95 to 99% HNO_3, it was found that complete miscibility of the phases took place. It is assumed that the extraction of HNO_3 proceeds according to the following equation: $m(HNO_3 \cdot nH_2O)_{aq} + DAMP_{org} \rightleftharpoons [(HNO_3 \cdot nH_2O)_m\ DAMP]_{org}$. Values of K_1 for this reaction expressing the total effect for the extraction of the trihydrate $HNO_3 \cdot 3H_2O \cdot$ DAMP and the monohydrate $HNO_3 \cdot H_2O \cdot$ DAMP were found to be 16.2 ± 0.6 for 100% DAMP, 10.9 ± 0.4 for up to 30 vol % DAMP in CCl_4, and 22.3 for 30 vol % DAMP in benzene. These values of K_1 were used to calculate distribution coefficients for HNO_3 over a wide range of acidity. The calculated values agreed well with experimental values. (21 references.) (TTT)

20271

BEHAVIOR OF COPPER NITRATE DURING THE EXTRACTION OF URANYL AND PLUTONIUM NITRATES WITH TRIBUTYLPHOSPHATE (TBP) SOLUTIONS. V. B. Shevchenko, I. V. Shilin, and Yu. F. Zhdanov. Zhur. Neorg. Khim. 5, 1366-74(1960) June. (In Russian)

The extraction of $Cu(NO_3)_2$ by TBP can be expressed by

the following equation: $Cu^{2+} + 2\ NO_3^- + xTBP \rightleftharpoons Cu(NO_3)_2 \cdot xTBP$. A series of distribution coefficients for $Cu(NO_3)_2$ were run at constant ionic strengths of 1, 3, and 5 at 20 to 100 vol.% TBP in benzene. A plot of log of the distribution coefficients for $Cu(NO_3)_2$ versus the log of the concentration of TBP showed that x = 2 at 20 to 60 vol.% TBP. The distribution coefficient for $Cu(NO_3)_2$ increased from 1.1×10^{-4} to 3.14×10^{-4} at an ionic strength = 5 with 20% vol.% TBP, on replacing benzene as a diluent with kerosene. An increase in water content with increasing copper content in the organic phase showed that the copper is extracted as a hydrated complex. It was shown that the distribution coefficient of $Cu(NO_3)_2$ is not affected by hydrogen ion concentration at constant nitrate concentration. On increasing the concentration of uranyl nitrate in the initial aqueous phase from 10 to 500 g/l, the distribution coefficient for $CU(NO_3)_2$ falls from 0.65×10^{-4} to 0.128×10^{-4} at 2.0 N acidity with 20% vol.% TBP in kerosene. The presence of $Al(NO_3)_3$ as a salting agent in the aqueous phase increases the distribution coefficient for $Cu(NO_3)_2$. With benzene as a diluent the composition of the extracted complex is $Cu(NO_3)_2 \cdot 2TBP \cdot H_2O$, while with the kerosene as a diluent the complex is $Cu(NO_3)_2 \cdot 3TBP \cdot 2H_2O$. (TTT)

20272

RECOVERY OF RADIOACTIVE CAESIUM. Harold Augustus Walker and Thomas Elwyn Edwards (to United Kingdom Atomic Energy Authority). British Patent 834,914. May 11, 1960.

A process is described for the separation of cesium from fission products. The cesium is precipitated from nitric acid solution with phosphotungstic acid. The resulting water-insoluble cesium phosphotungstate is converted to water-soluble cesium compounds by electrolysis. The resulting cesium compounds are treated with acid and evaporated to dryness to form dry cesium salts. (W.L.H.)

20273

IMPROVEMENTS IN OR RELATING TO ION-EXCHANGE PROCESSES. Alan Arthur North, John Henry Beaumont, and Ronald Arthur Wells (to United Kingdom Atomic Energy Authority). British Patent 836,155. June 1, 1960.

The resin-in-pulp ion exchange process is improved so that pulps of high solids content can be used without attrition loss of resin and preliminary removal of coarse solids. The resin is employed in the form of sheets, bonded by a thermoplastic resin, arranged vertically in a long tank provided with holes in its bottom for air passage to keep the solids in suspension. Ways are suggested for operating a series of such tanks for efficient separation of the solid metal. An example is given in the separation of U from U pulps of pH 1.5, sp. gr. 1.76, and solids content 60 wt.% obtained from uranium ore; the resin used in Deacidite FF bonded with polyethylene into $12 \times 15 \times 0.02$-inch sheets. After the sheets are loaded with U, they are eluted with a 1 N NaCl and 0.1 N H_2SO_4 solution. The capacity of a sheet is ~4 mg U_3O_8/cm^2. (D.L.C.)

20274

IMPROVEMENTS IN OR RELATING TO SOLVENT EXTRACTION OF URANYL NITRATE SOLUTIONS. Nathan Shulman (to United Kingdom Atomic Energy Authority). British Patent 836,691. June 9, 1960.

A process is presented for the treatment of HNO_3 solutions of neutron-irradiated U by an organic solvent, dibutyl ether of diethyleneglycol, for the separation of U and Pu from fission products. (W.L.H.)

20275

SEPARATION OF PLUTONIUM. (to United Kingdom Atomic Energy Authority). British Patent 839,190. June 29, 1960.

A method is presented for separating Pu from other substances by absorbing the Pu from solution on zirconium phosphate or barium iodate. (W.L.H.)

20276

SEPARATION OF FISSIONABLE SOLIDS FROM SUSPENSION. (to United Kingdom Atomic Energy Authority). British Patent 839,750. June 29, 1960.

A method is presented for separating solids from an irradiated slurry of fissionable materials in D_2O, which consists of centrifuging the slurry to separate a portion of D_2O, leaving a concentrated mixture of solids and D_2O, and separately centrifuging the concentrated mixture. (W.L.H.)

20277

SEPARATION OF PLUTONIUM FROM SOLUTION. (to United Kingdom Atomic Energy Authority). British Patent 839,749. June 29, 1960.

A process is presented for separating Pu from solutions by carrier precipitation. The Pu is precipitated with uranium hydroxide at a pH of 5.0. The precipitate is dissolved in mineral acid and the U is precipitated as hydroxide leaving the Pu in solution. (W.L.H.)

20278

SEPARATION OF URANIUM, PLUTONIUM AND FISSION PRODUCTS. (to United Kingdom Atomic Energy Authority). British Patent 840,105. July 6, 1960.

A process is presented for the separation of U and Pu from neutron-irradiated U. An aqueous nitric acid solution of the irradiated U is contacted with an organic solvent to remove the U and Pu. The resulting organic solutions are treated with a reducing agent to reduce the Pu to the tervalent state and the Pu is extracted with an aqueous nitrate salt solution. (W.L.H.)

20279

IMPROVEMENTS IN AND RELATING TO THE PURIFICATION OF URANIUM-BEARING MATERIALS. Howard Francis Gemperline and Raymond Anthony Foos (to Union Carbide Corp.). British Patent 840,160. July 6, 1960.

A process is described for the separation of uranium oxides from uranium-bearing materials. The uranium-bearing materials are leached with a kerosene solution of a dialkyl acid phosphate. The resulting leach liquor is scrubbed with aqueous mineral acid solution. The scrubbed leach liquor is contacted with hydrochloric acid, extracting the dissolved uranium oxides. The hydrochloric acid solution is evaporated, and the evaporation residue is calcined to uranium oxides. (W.L.H.)

20280

PROCESSES OF PRODUCING URANIUM ENRICHED WITH U^{235}. (to United Kingdom Atomic Energy Authority). British Patent 841,311. July 13, 1960.

A calutron process is described for the production of U enriched in U^{235}. Also included are processes for reclaiming U from the calutron and purifying the recovered U. (W.L.H.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

20281 AFSWC-TR-59-48

Illinois Inst. of Tech., Chicago. Armour Research Foundation and Air Force Special Weapons Center, Kirtland AFB, N. Mex.

BLAST EFFECTS ON TUNNEL CONFIGURATIONS. Final

Test Report No. 17 [on] BLAST EFFECTS ON BUILDINGS AND STRUCTURES AND PROTECTIVE CONSTRUCTION OPERATION OF SIX-FOOT AND TWO-FOOT SHOCK TUBES. James J. Swatosh, Jr. and Roman Birukoff. Oct. 1, 1959. 55p. ARF Project No. 4144. Contract AF29 (601)-796.

Pressure measurements were made in tunnel type models at the Air Force Shock Laboratory at Gary, Indiana. Tunnel overpressures were measured as a function of both geometric and free-stream blast wave parameters. The tunnels were oriented such that the major axis of the tunnels subtended angles of 0, 45, and 90 degrees with the direction of free-stream blast flow. These tunnels were loaded by free-stream shock strengths in the range of 3 to 15. Pressure-time records (overpressure as a function of time measurements) were obtained at various positions within the tunnels. The effect of surface roughness on pressure attenuation was investigated utilizing a range of surface roughness factors from 0 to 7%. Geometric variations in the tunnel complex included various expansion chamber configurations, short 90 degree bends, and entrance restrictions. It was shown that the peak overpressure, only one and one-half diameters from the tunnel's entrance, was of the order of 30 to 50% of the free-stream overpressure for 90 degree tunnel orientations. For tunnel orientations of zero degrees, the peak overpressure just inside the tunnel's entrance is greater than the initial free-stream overpressure, but considerably smaller than reflected pressure existing in the vicinity of the tunnel entrance. Overpressure near the entrance of the tunnels varied with both the orientation of the tunnel and with the magnitude of the free-stream shock strength. The attenuation of pressures further down the tunnels was a function of distance from the entrance, tunnel orientation, and tunnel geometric complex. Attenuation of pressure in smooth wall tunnels scaled according to the standard pressure-time scaling laws for the blast wave parameters tested. However, when wall roughness was introduced pressure and time did not scale, especially for large diameter tunnels. In effect the influence of wall roughness on attenuation became less pronounced as the absolute tunnel diameter increased. (auth)

20282 HW-58639

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DEVELOPMENTS IN THE HLO BEARING TEST PROGRAM; INTERIM REPORT. R. W. Wirta. Jan. 9, 1959. 25p. Contract AT(45-1)-1350. OTS.

A review of the bearing test program established to evaluate different combinations of bearing and journal materials operating in various solutions indicated that except from the standpoint of chemical compatibility and radiation stability, the materials and physical dimensions for pump bearings were not adequate. It was found that measuring the coefficient of friction did not offer the basic information desired. Continued studies were needed to evaluate new potential materials. To find a compatible pair of materials for a bearing-journal combination, at least three things had to be considered: chemical compatibility, radiation and thermal stability, and wear rate. A bearing test machine was developed for evaluating bearing-journal compatibility on a wear rate basis. Wear rates at boundary or sub-boundary lubrication conditions could be determined. Wear rate data are summarized. The bearing and journal materials are listed together with their surface finishes, radial clearance, speed, load, duration of test, wear, and wear rate. (M.C.G.)

20283 NAA-SR-Memo-4271

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

ELECTRICAL INSULATION PROGRAM FOR EM PUMP COILS, MATERIAL SCREENING PHASE. H. W. Lohman. Aug. 18, 1959. 10p. OTS.

Wire and sheet insulation, spray coatings for steel, and cements were evaluated as electrical insulation for electromagnetic pump coils and satisfactorily meet the requirement of one megohm cm volume resistivity at 1000°F. (C.J.G.)

20284 ORNL-2881

Oak Ridge National Lab., Tenn.

OAK RIDGE NATIONAL LABORATORY SAMPLER FOR THE TAMALPAIS UNDERGROUND NUCLEAR DETONATION EXPERIMENT. J. W. Landry. July 14, 1960. 19p. Contract W-7405-eng-26. OTS.

A sampler was designed and fabricated at ORNL and installed at the AEC Nevada Proving Ground. The sampler incorporated explosion-operated valves and special features for fast removal of the samples. Samples were drawn at predetermined time intervals of the gaseous products of an underground atomic device explosion on Oct. 8, 1958. (auth)

20285 ORNL-2947(p.42-3)

Oak Ridge National Lab., Tenn.

INSTRUMENT AND VALVE DEVELOPMENT. A. M. Billings and R. L. Moore. p.42-3 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

After 5540 hr of service in a 30-gpm slurry loop, the Zircaloy-2 plug and seat of a flushed-bellows Hammel-Dahl valve was found to have suffered considerable damage. The damage, however, was not catastrophic. Life-testing of 12 titanium stem-sealing bellows was completed. Average life of the 12 units tested was 24,139 cycles. Tests were performed in uranyl sulfate solution at 280°C, with 2300-psig pressure applied externally to the bellows. (auth)

20286 ORO-288

North Carolina State Coll., Raleigh.

THE DEVELOPMENT OF A THEORY OF PULSE COLUMN FLOODING BEHAVIOR. Progress Report No. 10 [on] THE PERFORMANCE OF CONTACTORS FOR LIQUID-LIQUID EXTRACTION. Frederick Philips Pike and E. E. Erickson. Apr. 20, 1955. 76p. Contract AT(40-1)-1320. OTS.

An intensive study of the available pulse-column flooding data on two binary systems led to the evolution of a theoretical picture of flooding behavior, and the demonstration that the equations thus derived aid greatly in expressing and interpreting flooding data on binary systems. Reliance was placed mainly on the flooding data for the benzene–water system, with auxiliary use being made of the data on trichloroethylene-water. Ideas concerning suitable ways of expressing and relating flooding capacity were derived by dimensional analysis, intuition and a detailed analysis of the flow patterns within a pulse column. These ideas were tested by a mathematical procedure previously developed, and evaluated by means of a statistical criterion. The use of this criterion served to evaluate ideas, and thus to point toward the more pertinent concepts. A theoretical picture of the flow and flooding conditions within the column is presented which leads to a summary of equations, and a particular equation which is the best expression to date for interpreting and expressing flooding data on binary systems. A treatment of the available data by the flooding equation is

illustrated. The indications are that this equation is a satisfactory relationship, that the major controlling variable is the average rate of pulsation (π_D), that the flow ratio V_D/V_C is a secondary but important variable, and that a third variable is hardly needed. According to the present development this third, rather unimportant, variable could be either amplitude or frequency, with amplitude being chosen here. A significant development was the evolution of dimensionless groups, or quantities readily interpreted as components of dimensionless groups. Flooding capacity was expressed as a ratio of the actual discontinuous phase flow rate to the theoretical flow rate. The controlling hydrodynamic feature was conceived as being π_D, a measure of the actual (average) velocity of jet flow thru the orifices. The flow ratio is dimensionless. The amplitude term could be readily interpreted as a component of a dimensionless ratio of dimensions. These formulations of quantities all have physical significance. It was concluded that this development of terms with physical significance, with which to express flooding behavior, would have an important interpretation in other studies, such as pressure drop, or rate-of-mass transfer. (auth)

20287 ORO-289

North Carolina State Coll., Raleigh.

THE MEASUREMENT OF DYNAMIC PRESSURE DROP IN A PULSE COLUMN. Progress Report No. 12 [on] THE PERFORMANCE OF CONTACTORS FOR LIQUID-LIQUID EXTRACTION. E. E. Erickson, R. M. Knight, and Frederick Philips Pike. Apr. 27, 1955. 99p. Contract AT(40-1)-1320. OTS.

An adequate technique and means were developed for the measurement of dynamic pressure drop across the perforated plates of a pulse column. The instrumentation involved is an adaptation of a standard, commercial electronic device, which converts pressure impulses impinging on a metallic diaphragm into a trace on an oscilloscope screen, where it may be recorded by photographic means. Pressure waves are measured at two locations. The differences between the two waves defines the pressure-drop relationship. The technique is reported in detail, together with a record of the various experiences during its development. For typical pulse column operations, it was demonstrated that the measurements can be precise enough for careful work. A limited set of measurements was made on pressure drop across 23 plates, each perforated with $\frac{1}{8}$-in. holes in a triangular pattern to provide 21% free space, installed at 2-in. intervals in a 1.96 in. internal-diameter glass column. Flow conditions were varied from non-flow, to single-phase flow with benzene and water, to two-phase counter-current flow of benzene and water. Pulsing conditions were varied from 40 to 80 cycles per minute, and in amplitudes from 0.2 to 2.0 in. Flow rates ranged from 15 to 129 ft/hr. The pressure-drop measurements were plotted as irregular, sinusoidal-like curves, against time. The peak values ranged from 3 to 29 in. of water, with an average precision of about 5%. While the modified instrument was reasonably satisfactory for measuring dynamic pressure drop, it appears that an improvement would result if it were further modified to read pressure drop directly, by suitably bucking the sensor signals from two locations. It also appears that some of the newer strain-gage instruments are more suitable for indicating pressure drop directly. (auth)

20288 ORO-290

North Carolina State Coll., Raleigh.

THE DEVELOPMENT OF A PULSE-COLUMN SAMPLING TECHNIQUE TO OVERCOME ENTRAINMENT. Progress Report No. 13 [on] THE PERFORMANCE OF CONTACTORS FOR LIQUID-LIQUID EXTRACTION. Eugene E. Erickson, Forest O. Mixon, Jr., and Frederick Philips Pike. Apr. 26, 1955. 55p. Contract AT(40-1)-1320. OTS.

A method of obtaining clear, homogeneous samples of the continuous phase of unstable dispersions which are characteristic of pulse column exit streams was developed. While for many purposes these dispersions cause little trouble, a trace of a second phase can seriously interfere with measurements of individual-film mass-transfer coefficients. A preliminary investigation revealed that fritted-glass tubular filters adequately removed the dispersed material from either phase, even when the emulsions were more finely divided than those produced by the pulse column. Pressure-drop studies showed that these filters are practical for the low flow-rates of the sampling lines. Temporary filter units, installed on the pulse-column and tested under operating conditions, gave added assurance that the fritted glass filters would accomplish the desired purpose. The information gained was utilized in designing effluent sampling sections, containing the fritted-glass tubular filters, for the column discharge lines. The units were constructed, installed and tested and have provided a satisfactory solution to the entrainment problem. The pressure-drop across the filter-tube at sampling flow-rates was compared with the pressure which is necessary to rupture the interface at the capillary entrance of a preferentially wetted membrane. Data for the separation of entrainment in the water phase indicate that the pressure-drops is well under the wetted membrane rupture pressure. The fact that the filter, which would be wetted preferentially by water, appears to operate satisfactorily also in the benzene phase lends support to an originally assumed analogy to the filtration of small particles suspended in a liquid. (auth)

20289 ORO-291

North Carolina State Coll., Raleigh.

COMPARATIVE PERFORMANCE OF EXPANDED-METAL PLATES IN A PULSE COLUMN EXTRACTOR (thesis). Jong Chul Park. Progress Report No. 16 [on] THE PERFORMANCE OF CONTACTORS FOR LIQUID-LIQUID EXTRACTION. 1956. 151p. Contract AT(40-1)-1320. OTS.

A new type of pulse column extractor plate was tested. The plates were made of expanded metal, a commercial product which serves particularly to give a side-component to the velocity of the liquid, and a flow pattern between plates which is different from that produced by perforated plates. In addition, they give more free space along the path of flow, per unit of plane area, greater stiffness, and have other physical differences. The expanded-metal plates were designated by the symbol EX and constructed of material specified as $\frac{1}{8}$ in. × 22 gage AISI 302 × $\frac{5}{64}$ in. The comparison perforated plates (P-25) were punched with round $\frac{1}{8}$-in. holes in a triangular pattern providing 25% free space. Measurements on plates P-25 and EX are included. The pulse column consisted of a 1.92-in. ID. Pyrex column containing 23 plates spaced 2.00 in. apart. It was operated at room temperature on purified benzene–water, with the benzene dispersed. Trace impurities were reduced to minimum levels. The reproducibility obtained implied success in these efforts. The major performance factors measured were C, the flooding capacity (efficiency) and ΔP, the average pressure drop as functions of π_D, the average pulsed flow past the plates. Additional observations were made on holdup, and on the flow patterns and column appearance. The comparison between the performance of the expanded-metal plates and the conventional perforated plates (from previous work) was made on the

bases of average pressure drop, and the product of the average pulsed flow rate by the average pressure drop. In both cases, the expanded metal plates were superior in permitting higher flooding capacities. This indicates that for a given power input, expanded metal plates would require pulse columns of smaller diameter. No measurements were made on the rate of mass transfer, the performance factor which controls column height. Attempts were made to characterize the resistance of plates, under unpulsed circumstances, so as to indicate their behavior in a pulse column. It was concluded that single and dual plates, unpulsed, do not act like a bundle of plates when pulsed. Therefore, plates to be assessed must be tested under actual pulse-column conditions. (auth)

20290 TID-4100(1st Rev.) Index

Technical Information Service Extension, AEC

ENGINEERING MATERIALS LIST. CUMULATIVE INDEX THROUGH SUPPLEMENT 7. Richard E. C. Duthie, ed. May 1960. 112p.

A cumulative index to the Engineering Materials List is presented which covers the CAPE-numbered packages of engineering materials. The materials covered include computers, critical assemblies, hot laboratory equipment, instruments, metallurgical equipment, radiation instruments, reactors, radiation source units, and shielded containers. (C.J.G.)

20291 AEC-tr-4127

INFLUENCE OF THE OIL FILM IN SLEEVE BEARINGS ON THE VIBRATIONAL BEHAVIOR OF THE SHAFT. (Der Einfluss des Ölfilms in Gleitlagern auf das Schwingungsverhalten der Welle). Erwin Krämer. Translated for Oak Ridge National Lab. from VDI Zeitschrift 102, 383-4(1960). 12p. (Includes original, 2p.). JCL.

The oil film in sleeve bearings of machine shafts influences the vibrations of the latter in various manners. The oil film changes the critical resolutions determined with bearings assumed to be inflexible and creates new resolutions. The oil film also attenuates the resonance deflection and causes self-excited vibrations. These phenomena frequently have a stronger effect than could be deduced from the relatively small lubricating-film thickness. (W.L.H.)

20292 CEA-tr-R-830

CINÉTIQUE DES ÉLECTRONS DANS LE CHAMP MAGNETIQUE D'UNE JAUGE MAGNÉTIQUE À IONISATION ET D'UNE POMPE IONIQUE. (Electron Kinetics in the Magnetic Field of a Magnetic Ionization Gage and an Ion Pump). G. V. Smirnitskaya and E. M. Reichrudel (Reinhrudel). Translated by [B.] Vinogradoff into French from Vestnik Moskov. Univ., Ser. Mat., Mekhan., Astron., Fiz. i Khim. 13, No. 2, 121-32(1958). 22p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 12835.

20293 UCRL-Trans-503(L)

ROTARY-PISTON PUMPS AND ROTARY-PISTON POWER ENGINES. Hans-Ulrich Tanzler. Translated by Esther Fultz (Univ. of Calif., Berkeley) from VDI Zeitschrift 91, 239-46(1949). 24p. JCL.

Designs and principles of operation of various types of rotary pistons which are employed in pumps and power engines are presented and discussed. 47 references. (C.J.G.)

20294

RESEARCH ON THE SUITABILITY OF INDUSTRIAL MATERIALS FOR CONSTRUCTION AND EQUIPPING OF ISOTOPE LABORATORIES. H. Koch (Institut für angewandte Radioaktivität, Leipzig). Kernenergie 3, 109-16(1960) Feb. (In German)

In the equipment of isotopes laboratories for different degrees of danger and various needs one must give particular attention to ventilation, waste, radiation protection, and contamination considerations. It is very important in this connection to know the mechanical and chemical behavior of individual construction materials as well as of the different radioisotopes. When construction of the Institute for Applied Radioactivity building began in 1956, there was only very little experience in this field. It was necessary to test covering materials for floors, walls, tables, and hoods, as well as protective covers for furniture and apparatus for their behavior with respect to the acids, alkalies, solvents, and radioisotopes to be used. For the latter tests, aqueous solutions of chemical compounds of Co^{60} and P^{32} were used. (tr-auth)

20295

REPAIR OF FAILED NUCLEAR THERMAL-HYDRAULIC EXPERIMENTAL LOOP VESSEL. E. B. LaVelle (General Electric Co., Richland, Wash.). Welding J. (N.Y.) 39, 802-7(1960) Aug.

The failure of one heavy wall stainless steel vessel used as container for a 100-kw heater in a thermal-hydraulic loop set up for the collection of data on the behavior of a reactor system under certain conditions is thoroughly discussed with respect to its repair (sectioning, re-joining, stress relief) and implications on current industrial practices. The failure, a longitudinal crack and microfissures in the shell section above the outlet nozzle, was interpreted to be due to the fabricator's substitution of a 6-inch cold section for the 22-inch cold section of the original design; this interpretation is supported by the discoloration of the area around the failure, indicating temperatures exceeding the design limit. Repair was made by supplementing the manual bleeders with a continuous bleed line, which was found to be effective in entrapped gas removal. (D.L.C.)

20296

PORTABLE BORING MACHINE. Wilfred Lord and Henry Sinclair Royce (to United Kingdom Atomic Energy Authority). British Patent 837,773. June 15, 1960.

A portable boring machine is described for boring objects which, by virtue of their shape or configuration, can not be accommodated on conventional machines. (W.L.H.)

20297

RADIATION RESISTANT LUBRICANT. Alan William Thomas Bateman and Kenneth Geoffrey Latham (to Esso Research and Engineering Co.). British Patent 839,061. June 29, 1960.

An emulsion lubricant is presented for the lubrication of frictional surfaces exposed to radiation. The lubricant consists of a water–oil emulsion in which the aqueous phase contains at least two moderators. The moderators are water-soluble inorganic salts with one having a thermal neutron cross section of at least 102 barns and the other a gamma ray absorption coefficient of at least 3. (W.L.H.)

20298

IMPROVEMENTS RELATING TO THE WRAPPING OF SOLID BODIES WITH POLYOLEFINS. (to General Electric Co.). British Patent 839,138. June 29, 1960.

A process is described for heat shrinking oriented or stretched organic polymers to make void-free structures. The process consists of wrapping an irradiation cross-linked polyolefin around a solid body and heating above 100°C. A layer of thermoplastic polyolefin having a softening point above 80°C is placed beneath the cross-linked

polyolefin and heating above 100°C fuses the two together. (W.L.H.)

20299

IMPROVEMENTS IN CENTRIFUGES. John St. Leger Philpot (to National Research Development Corp.). British Patent 839,622. June 29, 1960.

A turbine-driven centrifuge was invented for sedimentation spectrum measurements at and above 30,000 rpm. Its principle is the continuous feeding of a suspension liquid into a heavier layering liquid while the centrifuge is running; the feeding is done through jets at the bottom of the centrifuge and the sediment is collected differentially in pockets on the inner wall. The means of supporting the turbine, namely fluid spherical bearings, are discussed in detail. (D.L.C.)

20300

IMPROVEMENTS IN AND RELATING TO METHODS AND APPARATUS FOR IRRADIATING MATERIAL. Kenneth Hay Kingdon (to General Electric Co.). British Patent 839,874. June 29, 1960.

A method is reported for exposing materials to both an electric and radiation field at the same time and for pulsing one or both of the fields. Also reported is the apparatus for the irradiation of the materials which consists of a radiation source, electric field, supporting apparatus, and means to pulse the electric field and radiation source. (W.L.H.)

20301

IMPROVEMENTS IN OR RELATING TO NON-RETURN VALVES. Marshall Benjamin Bolt and Graham Llewellyn Hopkin (to United Kingdom Atomic Energy Authority). British Patent 840,232. July 6, 1960.

A non-return gas valve capable of operating satisfactorily in any position is described. The valve consists of a valve body having a gas outlet, an inner chamber with a gas inlet leading through the valve body, and an outer chamber within the valve body and surrounding the inner chamber. The inner chamber has a porous wall supported within the outer chamber so that it is always immersed in a high-surface-tension liquid partly filling the outer chamber. The outer chamber has a porous wall of which a portion is always out of contact with the liquid. (W.L.H.)

20302

IMPROVEMENTS IN FEED WATER ARRANGEMENTS FOR STEAM GENERATORS. Andre Huet. British Patent 840,479. July 6, 1960.

A means is described for the supply of feed water to a group of evaporator elements in a steam generator. According to the method a single element is selected as a pilot element for a group of evaporators, and an external water gage is attached. The arrangement assumes that the water and steam pressure losses inside each of the various grouped elements are identical so that the level readings of the pilot element apply to all the elements of the group. (W.L.H.)

Heat Transfer and Fluid Flow

20303 ANL-5735

Argonne National Lab., Ill.

NATURAL AND FORCED-CIRCULATION BOILING STUDIES. J. F. Marchaterre, M. Petrick, P. A. Lottes, R. J. Weatherhead, and W. S. Flinn. May 1960. 47p. Contract W-31-109-eng-38. OTS.

The tabulated local steam volume fraction data from an investigation of natural and forced-circulation boiling systems are presented. The experimental equipment is described and the correlation of the experimental data is briefly discussed. The data were taken for natural and forced circulation in $\frac{1}{4}$ by 2 by 60 in., and $\frac{1}{2}$ by 2 by 60 in. rectangular channels over a velocity range of 1 to 6 ft/sec, and a quality range of 0 to 6%. (auth)

20304 ANL-6175

Argonne National Lab., Ill.

OBSERVATIONS ON TRANSITION BOILING HEAT TRANSFER PHENOMENA. Bernard J. Stock. June 1960. 78p. Contract W-31-109-eng-38. OTS.

A study was made of boiling heat transfer from a horizontal tube to a saturated liquid at atmospheric pressure in the nucleate, transition, and film boiling regions. Particular consideration was given to the beginning and end of the transition boiling region. Two liquids were used, Freon 11 and demineralized water. An attempt was made to determine what changes in the boiling curve can be produced by wide variations in the surface. Both metalic and non-metalic surfaces were studied. The results indicated: (1) that $(Q/A)_{max}$ for these conditions is almost a constant and is unaffected by a shift of $(\Delta T)_{max}$ of as much as 40°; (2) $(\Delta T)_{max}$ is strongly dependent on surface conditions; (3) that data in the transition region are highly unstable, depending on surface conditions and on wetting properties of the liquid; and (4) that the inception of transition boiling is marked by violent motions of a two phase mixture which alternately approaches and is driven from the heated surface. Thus a vapor film is gradually produced as the surface temperature rises, and stable film boiling is established only when the surface temperature becomes relatively constant, such that: (1) the liquid does touch the surface during transition boiling; (2) there is no unique minimum point; (3) the minimum point does not necessarily mark the dividing line between transition and film boiling; and (4) the criterion for stable film boiling should be the absence of fluctuations in the surface temperature. Heat transfer data for water and Freon 11 in all the boiling regimes are presented. (auth)

20305 NP-8837

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

GENERALIZED HEAT TRANSFER FORMULAE AND GRAPHS. Research Report No. 72. R. W. Detra and H. Hidalgo. Mar. 1960. 19p. Contract AF04(645)-18.

Utilizing the research results of previously reported investigations of the laminar, turbulent, and radiative heat transfer in dissociated air, some generalized formulas for calculating heat transfer are given. Graphs for determining the laminar heat transfer, momentum thickness Reynolds number, and turbulent heat transfer distributions around an axi-symmetric body are also given. These heat transfer correlations are valid for velocities between 6000 and 26,000 ft/sec and for altitudes up to 250,000 ft. This range of velocities and altitudes covers the important re-entry regime of practical re-entry trajectories having interest today. The generalized results are specialized for ICBM nose cone re-entry applications. These formulae and graphs may be found useful for making rapid engineering estimates and preliminary design evaluations of the heating problems associated with re-entry into the Earth's atmosphere. (auth)

20306 NP-8871

Michigan. Univ., Ann Arbor.

CONTRIBUTIONS TO THE THEORY OF HYDRODYNAMIC STABILITY (thesis). I. V. Schensted. June 1960. 117p. UMRI Project No. 03114. Contract Nonr 1224(15).

The proof of expansion theorems relating to the expan-

sion of arbitrary functions in terms of the eigenfunctions of the plane parallel flow stability problem and those of the stability problem for the flow through a circular pipe is presented. These investigations show that such expansions are valid for functions which satisfy certain boundary conditions and regularity conditions which are specified in the text. Application of these expansion theorems to the solution of the initial value problem, to the solution of the forced oscillation problem, and to the non-linear problem are given. The approximate location of some of the eigenvalues of the parallel flow stability problem and of the stability problem for the flow through a circular pipe are also given. (auth)

20307 NP-8910

Stanford Univ., Calif.

EXTENSION OF COOLING FIN THEORY—APPLICATION TO AXIAL FLOW HEAT TRANSFER SURFACES WITH LONGITUDINAL FINS. Technical Report No. 47. R. K. Pefley. Oct. 31, 1959. 54p. Contract Nonr 225(23).

Analytical solutions describing gas and fin temperatures and cooling resistances were obtained for uniform flow of a cooling fluid between parallel fins with uniform heat input at their roots. One solution employs the standard cooling fin equation. For predicting fin temperatures or cooling resistance, the two solutions yielded the same result; assuming the heat exchange to be of the type commonly encountered between metal fins and gases, gas temperature profiles would be considerably different for the two solutions. Contrasting the derived solutions with an experimental system of wedge-shaped passageways for the gas flow revealed that the departure from nonuniform mass flow per unit width of passageway caused significant discrepancies between predicted and experimental results. (C.J.G.)

20308 OOR-407:53

Maryland. Univ., College Park.

THREE TYPES OF FLOW PAST A BODY AT LOW MAGNETIC REYNOLDS NUMBER. Interim Technical Report No. 44 on FUNDAMENTAL RESEARCH IN APPLIED MATHEMATICS. G. S. S. Ludford. Jan. 1960. 19p. DA Project No. 5B99-01-004. Contract DA-36-034-ORD-1486. (AD-231815).

Types of flow for which the magnetic Reynolds number is small were analyzed for the cases: (1) inviscid flow, weak magnetic field, (2) slow viscous flow, weak magnetic field, and (3) inviscid flow, very strong magnetic field. Flow dimensions and drag coefficients were studied for each case. (C.J.G.)

20309 ORO-293

North Carolina State Coll., Raleigh.

LIQUID-LIQUID HEAT TRANSFER IN A PULSE COLUMN (thesis). Stanley Chienpin Li. Progress Report No. 18 [on] THE PERFORMANCE OF CONTACTORS FOR LIQUID-LIQUID EXTRACTION. 1957. 136p. Contract AT(40-1)-1320. OTS.

An existing laboratory pulse-column unit developed for mass transfer studies was successfully modified to permit studies of agitated liquid-liquid heat transfer. In the present stage of development, heat transfer performance can be measured with a precision better than 10%. The unit is flexible, and capable of many types of basic studies over a wide range of operating conditions. The characteristics of the particular unit developed are given. The operating experience demonstrated that the single feed-stream temperature control was within 0.01°C. The thermopiles were sensitive and responsive within 0.01°C. The column insulation was adequate. Considering the need to establish steady-state conditions, one run could be made within no more than 2 hours. Under good conditions, up to four runs per day were possible. Several minor sources of error remained uncorrected, but the net effect was an average discrepancy of only 6.6% in the heat balances. Experience indicated a number of means by which this error could be appreciably reduced. To demonstrate the effectiveness of the modified unit, a limited series of heat transfer runs were made on the benzene–water system. The benzene was dispersed in a countercurrent stream of water which formed the continuous phase and wetted the plates. The direction of heat transfer was from water to the benzene droplets. Although it was known that the flow ratio is a major operating variable, this ratio was fixed at 1.0, on a volumetric basis for simplification of calculations. The two countercurrent flow rates were 20 ft/hr in the column. The pulsing rate was varied from as low as feasible, π_D = 50 ft/hr, up to close to the flooding rate, which was at approximately π_D = 1200 ft/hr. The experimentation demonstrated that for heat transfer, the behavior fell into two separate and distinct patterns depending upon the rate of pulsing. Below the transition pulsing rate of about π_D = 500 ft/hr, the heat transfer coefficients were approximately constant. Above the transition pulsing rate, the values for the heat transfer coefficients became strongly influenced by the pulsing rate. Faster rates of pulsing led to poorer coefficients of heat transfer. Heat transfer performance was not so good as that predicted. It was surmised that these discrepancies were related to the degree of back mixing that was occurring, in conjunction with the magnitude of the temperature gradients between the phases. (auth)

20310 ORO-295

North Carolina State Coll., Raleigh.

AGITATED LIQUID-LIQUID HEAT TRANSFER. A Study of the Influence of Temperature Driving Force on the Heat Transfer Coefficient in a Pulsed, Counter-Current, Sieve-Plate Contactor (thesis). Robin Pierce Gardner. Progress Report No. 21 [on] THE PERFORMANCE OF CONTACTORS FOR LIQUID-LIQUID EXTRACTION. 1958. 117p. Contract AT(40-1)-1320. OTS.

In a continuation of previous work, the heat transfer behavior of a pulse column was explored by further runs. The heat was transferred from water to benzene dispersed under a constant pulsing rate, π_D = 150 feet per hour, and a constant water rate, V_C = 20 feet per hour. The term π_D is defined as the average flow rate of total material past the plates in the direction of the discontinuous phase flow, averaged over the actual time of flow in that direction in feet per hour. The run conditions were chosen so as to settle a specific question raised by previous observations. A simple pattern of heat transfer behavior was previously observed; however, the rate coefficients were fairly constant up to a pulsing rate of π_D = 600, after which they varied exponentially with π_D. In the region of lower π_D, the variations that did exist in the measurements implied that perhaps the temperature driving force was a variable that influenced the heat transfer coefficients somewhat. By treatment of the data obtained in the restricted region of operation, π_D = 150 feet per hour and V_C = 20 feet per hour, satisfactory correlations were obtained and are included. The inlet benzene temperature varied from 25.63 to 31.57°C, while the inlet water temperature varied from 34.53 to 63.6°C. Calculations indicate that the average final (logarithmic) temperature differences (ΔT_{lm}) between phases in the column has small influence on the coefficients. The influence is probably big enough to require that ΔT_{lm} be included as a variable in future studies of heat

transfer coefficient behavior. It is concluded that the heat flow is a function of the over-all heat transfer coefficient and the differences in phase temperatures. (auth)

20311 JPRS-2897

AXIALLY SYMMETRICAL MERIDIAN FLOW OF A CONDUCTING FLUID. BALANCING THE PARAMETERS OF THE ROTATIONAL FLOW OF A VISCOUS FLUID. G. L. Grodizovskii (Grodizovskiy), A. N. Dyukalov, V. V. Tokarev, and A. I. Tolstykh. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekh. i Mashinostr., No. 1, 41-6(1960). 10p. OTS.

Equations are derived for calculating the axially symmetrical meridian flow of a conducting fluid. (W.L.H.)

20312

NUMERICAL MATHEMATICAL ANALYSIS. Sam H. Davis, Jr. (Rice Inst., Houston, Tex.). Chem. Eng. 67, No. 16, 137-42(1960) Aug. 8.

Numerical approximations for the partial differential equations in unsteady-state heat transfer may be derived by the use of either polynomials in time and the coordinates or physical models of the actual problem. The particular problem of a solid initially at a uniform temperature T_0, suddenly immersed in a fluid at temperature T, was considered because the analytical solution to the problem was known and the results of the approximation could be checked. The problem was adapted for automatic computer calculation and the centerline temperature ratios were calculated by open and closed approximation. The closed approximation gave a much smaller error than the open. (M.C.G.)

20313

CERTAIN PROBLEMS OF NON-STATIONARY HEAT TRANSFER IN A LAYER OF DISPERSE MATERIAL. G. D. Rabinovich (Inst. of Power Engineering, Academy of Sciences, BSSR, Minsk). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 4, 73-80(1960) Apr. (In Russian)

On the basis of the solution by the integral transform method of a differential equation for recuperative apparatus, temperature fields are determined in a liquid flowing through a layer and in the layer itself for a sufficiently small value of the Bi criterion, when inner sources of heat are present within the layer. The solution is found for sources: $q = \text{const}$, $q = a(t'' - t_0)$, and $q = a(t'' - bt')$. (auth)

20314

THE NON-STATIONARY TEMPERATURE FIELD IN HEATING ELEMENTS OF A REACTOR. V. S. Ermakov (Inst. of Power Engineering, Academy of Sciences, BSSR, Minsk). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 4, 127-31(1960) Apr. (In Russian)

An analytical solution is given of the differential equation of heat conductivity which is applicable to the determination of the distribution of temperature along a heat producing rod of a nuclear reactor under non-stationary conditions. Equations are given which give solutions for the cases when (1) the reactor is supercritical with relation to the prompt neutrons, and (2) taking into account delayed neutrons.

20315

HEAT TRANSFER DURING THE BOILING OF LIQUIDS IN TUBES. I. P. Vishnev and N. K. Elukhin (Inst. of Oxygen Machine Construction, Moscow). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 5, 74-80(1960) May. (In Russian)

The heat transfer factors for liquids boiling in tubes depends on their over-all dimensions when length/diameter >80. Heat transfer during boiling of a liquid in various conditions can be calculated from the reduced vapor rate. For the analysis of heat transfer during boiling, a criterial equation is given. From this criterial relationship a formula is obtained for the determination of heat transfer during boiling of liquids in tubes and in large volume. (auth)

20316

AN INVESTIGATION OF PROCESSES OF HEAT TRANSFER IN FUEL ELEMENTS OF NUCLEAR REACTORS BY THE HYDRAULIC ANALOG METHOD. O. I. Yaroshevich (Inst. of Power Engineering, Academy of Sciences, BSSR, Minsk). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 5, 81-5(1960) May. (In Russian)

The one-dimensional problem is considered for the distribution of a temperature field with inner heat sources applicable to fuel elements of water-moderated water-cooled reactors. Boundary conditions of the fourth type are used on contact boundaries of separate layers of fuel elements, and conditions of the third type on inner surfaces. The dependence of the coefficient of heat conductivity on temperature is applied. The problem is solved by the hydraulic analog method on the hydrointegrator of V. S. Lukyanov. The results are presented in the form of graphs. (auth)

20317

THE NON-STATIONARY TEMPERATURE FIELD IN HEAT-PRODUCING ELEMENTS OF A REACTOR. V. S. Ermakov (Inst. of Power Engineering, Academy of Sciences, BSSR, Minsk). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 5, 115-18(1960) May. (In Russian)

The problem of temperature field determination in a finite cylinder with an internal heat source which is an arbitrary function of both the co-ordinates and time was solved by the internal transformation method. The heat flux is given at the external surface of the cylinder. The solution of the problem is of interest for the heat process model in a reactor core. (auth)

20318

THE TEMPERATURE FIELD IN A FINITE CYLINDER WITH INNER SOURCES. T. L. Perel'man (Inst. of Power Engineering, Academy of Sciences, BSSR, Minsk). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 5, 138-44(1960) May. (In Russian)

By the integral transform method with finite limits, a solution is obtained to the problem of the temperature in a finite cylinder with volume sources of heat for various limit conditions on the ends of the cylinder and convection heat exchange on the side surface. The result is of interest in the study of heat transfer in nuclear reactors. (auth)

20319

HEAT TRANSFER TO WATER AND ETHYL ALCOHOL WHERE NATURAL CONVECTION OCCURS NEAR THE CRITICAL POINT. E. A. Kazakova. Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 6, 3-8(1960) June. (In Russian)

The lack of correspondence of generally accepted equations for natural convection with experimental values of α is shown for water at pressures above 100 atm. Near the critical point of divergence the difference may be as large as 200%. For the field beyond the critical point an empirical equation is proposed. The coefficients of heat exchange for film boiling of ethyl alcohol are approximately 10% higher than the values of α for heat transfer during natural convection to alcohol in a single-phase state at a pressure somewhat higher than critical. At pressures higher than critical, in experiments with ethyl alcohol, curves of $\alpha = f(\Delta t)$ show maxima which agree qualitatively with curves of change of heat capacity and of the coefficient of volume expansion. Critical heat flows are obtained for the transition

from bubble boiling to film boiling (q_{kp_1}) and film boiling to bubble boiling (q_{kp_2}) when ethyl alcohol is boiled in pressure intervals close to critical. (auth)

20320

THE APPLICATION OF THE THEORY OF THERMODYNAMIC SIMILARITY TO THE DETERMINATION OF PHYSICAL PROPERTIES OF LIQUID METALS. G. F. Butenko and M. I. Radchenko. Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 6, 66-71(1960) June. (In Russian)

It is shown that the Lorents function of fused metals can be expressed by an equation. For liquid metals belonging to one thermodynamic group a relationship was established between the dimensionless Lorents function and dimensionless viscosity. Formulas are given which are suitable for liquid metals contained in one thermodynamic group. Results of calculations are compared with experimental data. (auth)

20321

THERMAL TESTING OF REACTOR FUEL ELEMENTS. J. H. Monaweck and W. J. McGonnagle (Argonne National Lab., Ill.). p. 352-7 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

Thermal tests are used to determine the integrity of the cladding and bond between the fuel and can in reactor fuel elements. Two techniques are described which are used in the thermal tests: the isothermal frost test and thermography. The limitations of the frost test are discussed in connection with heat barriers. In the thermographic method, a temperature-sensitive phosphor is used and is an improvement on the isothermal frost test. Data indicate that the thermographic method can detect metal-to-metal contact of approximately 0.095 in. in width when the material is a maximum of 0.060 in. thick. (B.O.G.)

Instrumentation

20322 AD-232692

Texas. Agricultural and Mechanical Coll., College Station.
PRELIMINARY STUDIES AND TESTS OF SEMICONDUCTORS FOR THEIR USE AS NUCLEAR DETECTORS (thesis). Giles Whitehurst Willis, Jr. Jan. 1960. 50p.

Basic principles of junction semiconductors are presented. Some circuits that may be used in testing junction semiconductors for use as primary instruments for detecting nuclear radiation are described. Tests on diodes revealed that thermal pulse noises are dependent on both the current through the junction and on the temperature of the junction. Decreasing the temperature to 0°C did not discernibly decrease the thermal noise pulse rate but did stabilize the volt-ampere characteristics. It is postulated that diodes with a breakdown voltage of less than 8 volts will not produce any thermal pulses when they are reverse biased. (C.J.G.)

20323 AD-233429

Battelle Memorial Inst., Columbus, Ohio.
EXPERIMENTAL AND RESEARCH WORK IN NEUTRON DOSIMETRY. Quarterly Progress Report No. 2 for the Period August 15 to November 14, 1959. J. E. Drennan, A. R. Zacaroli, O. J. Mengali, R. K. Crooks, H. C. Groton, and C. S. Peet. Nov. 15, 1959. 39p. Contract DA 36-039 SC-78924.

Two sets of dosimeter-rectifiers were produced using modifications of previously developed techniques for the construction of wide-base, conductivity-modulated, silicon-diffused rectifiers. The primary process modification employed was that of cooling the device at a low, controlled rate following the diffusion of boron. The modifications were designed to obtain higher initial charge-carrier lifetimes. Experiments were carried out to investigate the sensitivity of dosimeter-rectifiers to gamma and fast neutron radiation. Theoretical studies indicated, and experimental work tentatively verified, that gamma exposure would not affect significantly the dosimeter-rectifier parameters in the dose range of interest. Theoretical work also indicated that thermal neutron radiation should not cause a significant change in the dosimeter performance of the dose range of interest. The percentage change of d-c forward resistance with neutron dose did not differ significantly from that for an incremental resistance at a given forward applied voltage. (M.C.G.)

20324 ANL-6186

Argonne National Lab., Ill.
COUNTING INDIVIDUAL ALPHA ACTIVITIES IN MIXTURES. John Sadauskis. June 1960. 20p. Contract W-31-109-eng-38. OTS.

A reproducible method for directly determining individual alpha activities in mixtures in which there are sufficient differences in alpha energies to give separation of the spectrum peaks was developed. A gridded ionization chamber, connected with a 10-channel analyzer, at first, and later to a 100-channel analyzer, was used together with suitably thin source. The chamber gas was a mixture of 90% argon and 10% methane. (auth)

20325 CEA-1401

France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay.
REALISATION D'UN CHRONOTRON POUR SPECTROMÈTRE À NEUTRONS RAPIDES PAR TEMPS DE VOL. (Development of a "Chronotron" for Time of Flight Fast Neutron Spectrometer). J. Duclos. 1960. 48p.

Thesis submitted to Univ. of Grenoble.

A chronotron using storage circuits of a 100-channel amplitude analyzer was developed in order to measure the time of flight of fast neutrons. A time dilatation is obtained by a distribution of 20 6BN6 tubes. The width at half maximum of a prompt coincidence curve is $1.6 \cdot 10^{-9}$s for β-γ coincidences from Ar^{198} and 2.10^{-9}s for n-α coincidences from (d,t) reaction. (auth)

20326 CEA-1424

France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay.
TRAITEMENT DES INFORMATIONS EN REGIME STATISTIQUE. APPLICATIONS A L'ELECTRONIQUE NUCLEAIRE. (Statistical Treatment of Data. Applications to Nuclear Electronics). F. Sicard. [Oct. 1959]. 32p.

The data of probability calculations are applied to the analyses of counting losses in experiments on chance events encountered in nuclear physics. The distribution of time intervals according to Poisson's law is studied and various applications of this are given: calculation of counting losses on a scale preceded by a fast demultiplying circuit, decrease of the counting rate on the multichannel selectors, recording of statistical distribution phenomena on magnetic bands. (auth)

20327 CEA-1431

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay, France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires,

Grenoble; and Grenoble, France. Université. Laboratoire de Physique Nucléaire.
CIRCUIT DE COINCIDENCE DIFFERENTIEL DANS LE DOMAINE DE 10^{-10} SECONDE. (Differential Coincidence Circuit in the 10^{-10} Second Region). R. Van Zurk. 1960. 27p.

A coincidence circuit of low resolution time using the differential coincidence Bay principle is described. It uses three 6BN6 tubes ordered to chronotron structure. Results with Radiotechnique 56 AVP photomultipliers and for Co^{60} γ-γ coincidences are 4 to 6.10^{-10} s (full width at half maximum) if the efficiency is ϵ = 40% and 7 to 2.10^{-10} sec at ϵ = 85%. (auth)

20328 GAT-T-588(Rev. 1)
Goodyear Atomic Corp., Portsmouth, Ohio.
INTEGRAL CONTROL FOR AUTOMATIC BEAM-POSITIONING IN MASS SPECTROMETERS. M. L. Hanson. July 22, 1960. 19p. Contract AT(33-2)-1. OTS.

A means of controlling the position of the ion beam in a mass spectrometer with respect to the slit was developed. Positioning is accomplished by varying the accelerating voltage in accordance with the integral of a voltage proportional to the position error. The error is defined by the amplitude and phase of an a-c component in the collector current. Excellent control of beam position was achieved at no sacrifice in analytical precision. Modular design permitted a high ratio of operational time to down time. (auth)

20329 HW-38191
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
MANUAL FOR THE EFFLUENT WATER GAMMA MONITOR. M. C. Greene, R. S. Paul, and M. R. Wood. [nd]. 34p. OTS.

A manual is presented which includes a general description of the gamma monitor system designed to detect fuel element failures in reactors by monitoring the effluent water for traces of fission products. Aspects of application to rupture detection are outlined, and operating procedures are given along with maintenance instructions. (J.R.D.)

20330 HW-64744
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SPECIFICATIONS FOR THERMOCOUPLES, STAINLESS STEEL SHEATHED, CORROSION RESISTANT, FOR NUCLEAR SERVICE. Bert S. Kosut. Apr. 11, 1960. 3p. OTS.

The requirements are presented for corrosion-resistant, metal-sheathed, two-wire thermocouples for nuclear service at elevated temperatures in contact with primary coolant, liquid metals, gaseous atmospheres, or a combination of two or more of these media. (auth)

20331 SCR-107
Sandia Corp., Albuquerque, N. Mex.
RADAR RETURN FROM THE VERTICAL FOR GROUND AND WATER SURFACES. Charles S. Williams, Jr., Charles H. Bidwell, and Douglas M. Gragg. Apr. 1960. 91p. OTS.

Strength measurements of pulse radar return from the vertical for a variety of ground and water surfaces at 415 and 3800 Mcps are given. The radars were carried in low-speed aircraft that made straight and level runs at various altitudes over terrains that may be categorized into a number of general types. The expected upper and lower limits of radar return strength from several types of terrain may be estimated. (J.R.D.)

20332 SCTM-179-60(51)
Sandia Corp., Albuquerque, N. Mex.
POWER REQUIREMENTS FOR SPACE COMMUNICATIONS. R. J. Thompson. July 1960. 27p. OTS.

Some factors affecting the power requirements for the transmission of information from a space vehicle to a receiving station on earth are discussed. The theoretical minimum power requirements for an ideal communication system are presented, and the capabilities of several types of systems are compared with the ideal. (auth)

20333 UCRL-5924-T
Stanford Research Inst., Menlo Park, Calif.
A GRAZING INCIDENCE VACUUM SPECTROGRAPH OF SIMPLE DESIGN. Raymond L. Kelly. Apr. 1960. 16p. For Univ. of California. Lawrence Radiation Lab. Contract W-7405-eng-48. OTS.

A grazing incidence vacuum ultraviolet spectrograph was built for studies of high-temperature plasmas. It is a survey instrument which covers the range 100 to 2250A and is small enough to be moved to machines where it is necessary to make measurements. The design uses a concave grating with a 1-meter radius of curvature and 600 grooves per mm. Incident light strikes the grating at an angle of 82°, and the diffracted light is collected on a film strip held along the Rowland circle. (auth)

20334 WCAP-6043
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS) PHASE II PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1960. July 1, 1960. 42p. Contract AT(30-1)-2176, Task I. OTS.

A summary of activities during the semi-annual period ending June 30, 1960 on a N^{16} monitor for measuring reactor power and coolant flow rate, and on the development of non-destructive assay techniques for reactor fuel elements is presented. Other NMCS work programs were terminated prior to this report period, and terminal reports were issued. Design studies on the N^{16} instrumentation and the results of pre-design experiments at the Westinghouse Testing Reactor (WTR) are discussed. Reactor power and coolant flow rate data obtained with WTR conventional instruments are compared to values calculated from N^{16} measurements. Two automatic recording instruments for the prototype N^{16} monitor were tested and modified prior to shipment to the Army Packaged Power Reactor. The equipment was installed and calibrated at the APPR-1 site. Evaluation testing will commence about July 1, 1960. The Fuel Assay Scanner, designed and constructed for the assay of MTR and ETR type fuel elements, was successfully evaluated under typical field conditions at the Materials Testing Reactor. Experiments were completed on the assay of large geometry, low enrichment fuel elements by fast neutron activation and delayed neutron counting. The results indicate that a device operating on such principles is feasible. (For preceding period see WCAP-6037.) (auth)

20335 CEA-tr-R-831
MANOMÉTRE POUR LA MESURÉ DE LA PRESSION DE GÀZ CORROSIFS. (Manometer for Measurement of the Pressure of Corrosive Gases.). R. Kh. Burshteĭn and D. L. Kondrashov (Kondrachov). Translated into French from Zhur. Fiz. Khim. 33, 1653-4(1959). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 20119.

20336 CEA-tr-R-836
MANOMÉTRE À MEMBRANE À AUTO-COMPENSATION.

(Manometer with Self-Compensating Membrane.). K. V. Chmutov, V. S. Lapik, P. M. Kalachev, and Yu. A. Silkin (Iu. A. Silkine). Translated into French from Zhur. Fiz. Khim. 33, 1655-6(1959). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 20120.

20337 SCL-T-316

North Atlantic Treaty Organization, Paris. Advisory Group for Aeronautical Research and Development. PRESSURE TRANSDUCERS AND MINIATURE MANOMETERS APPLICABLE IN WIND TUNNELS AND IN FLIGHT. (Capteurs de Pression et Manometres Miniatures Utilisables en Soufflerie et en Vol). M. Bassiere. Translated by A. A. Horvath (Sandia Corp.) from report AGARD-173, Mar. 1958. 24p. JCL.

The operation and performance of optical, telemetric, and miniature strain-gage manometers and pressure transducers for wind tunnel and flight pressure measurements are discussed. Methods for the dynamic calibration of manometers are described. Designs of the various instruments are included. (C.J.G.)

20338 SCL-T-317

A PIEZO-QUARTZ DYNAMOMETER FOR MEASURING IMPACT STRESSES. N. A. Andreevskiĭ (Andreevski). Translated by Marcel I. Weinreich (Sandia Corp.) from Zhur. Tekh. Fiz. 9, 680-6(1939). 13p. JCL or LC.

The fabrication of a piezo-quartz dynamometer which is to be used in obtaining diagrams of a shock burst in the form of a load curve as a function of time is described. The performance, operation, and calibration of the dynamometer are discussed. (C.J.G.)

20339 TT-893

NEW METHOD OF CALIBRATING A TRICOLOUR COLORIMETER. (Novyi Sposob Graduirovki Trekhtsvetnykh Kolorimetrov). N. V. Lobanova. Translated by G. Belkov (National Research Council of Canada) from Svetotekhnika 1, No. 4, 7-9(1955). 6p. NRC or JCL.

A method of calculation for calibrating a tricolor colorimeter is described. For calibration using this method it is sufficient to know the coordinates of the chromaticity of the fundamental colors red, blue, and green of the instrument and to have some measurement data of the source taken with the instrument being calibrated. The chromaticity coordinates of the fundamental colors of the instrument are determined by spectrophotometric measurements and color calculations. (C.J.G.)

20340

SCINTILLATION COUNTING OF PAPER CHROMATOGRAMS. Robert Berner Loftfield and Elizabeth Ann Eigner (Massachusetts General Hospital, Boston). Biochem. Biophys. Research Commun. 3, No. 1, 72-6(1960) July.

The distribution of radioactivity in a paper chromatogram was determined by direct counting by immersion of the paper in a scintillation solvent. This system was used to determine the relative amounts of carbon-14 radioactivity in compounds such as valine and valine hydroxamate. In order to control orientation of the paper strip with respect to the phototube, the sections were rolled into a closed cylinder form lengthwise. It was found that uneven drying and variations in the eluting buffer concentration caused variations in counting efficiency. (M.C.G.)

20341

A METHOD TO INCREASE THE LUMINOSITY OF A TIME-OF-FLIGHT SPECTROMETER FOR SLOW NEUTRONS. Daniel Cribier (Centre d'Études Nucléaires, Saclay, France). Compt. rend. 251, 230-1(1960) July 11. (In French)

The principle of a time-of-flight spectrometer for slow neutrons is described in order to propose an apparatus permitting the luminosity of the apparatus to be increased without decreasing its resolution. (tr-auth)

20342

REMARKS ON EVALUATION OF THE SPURIOUS COUNTS IN COINCIDENCE'S MEASUREMENTS. R. Somigliana (Istituto di Fisica del Politecnico, Milan). Energia nucleare (Milan) 7, 495-6(1960) July. (In English)

The methods of evaluation of the spurious counts in coincidence measurements done by means of radiation detectors are discussed in the particular case of a radiation source that decays with the emission in cascade of two simultaneous and uncorrelated radiations in presence of random noise pulses. (auth)

20343

DOSE CHARACTERISTICS OF IONIZATION CHAMBERS AND A LARGE SCINTILLATION CRYSTAL. V. I. Kukhtevich, E. S. Matusevich, B. P. Shemetenko, and L. A. Trykov. Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 4, 125-6(1960) Apr. (In Russian)

Dose characteristics of an ionization chamber, the dimensions of which are comparable with the range in air of secondary electrons formed by primary γ rays and scintillating primary γ rays; and of a scintillating organic crystal, for which the absorption of primary radiation is known, are determined. The region of energies of primary γ radiation from 0.08 to 2 Mev is considered. Results are shown in graphical form. (auth)

20344

LARGE DOUBLE FOCUSING α-SPECTROMETER. S. A. Baranov, A. G. Zelenkov, G. Ya. Shchepkev, V. V. Beruchko, and A. F. Malov. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1402-10(1959) Dec. (In Russian)

The design and performance of a highly resolving, maximum luminosity, double-focusing α spectrometer with a central orbit radius of $\rho = 155$ cm are described. (R.V.J.)

20345

NEW ELEMENTS IN THE CALCULATION OF α-SPECTROGRAPH WITH DOUBLE FOCUSING. A. G. Zelenkov. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1411-15(1960) Dec. (In Russian)

The principle characteristics of double focusing α spectrographs are analyzed, and new equations are developed for describing distribution, surface focal shape, dispersion, and resolving power. (R.V.J.)

20346

CHARACTERISTICS OF NEW PHOTOELECTRON MULTIPLIERS. A. G. Berkovskiĭ, I. Ya. Berido, O. S. Korol'kova, and L. G. Leiteizen. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1517-19(1959) Dec. (In Russian)

Descriptions are given of two new photomultipliers. The PEM-35 has a 25 mm cathode diameter with maximum $\phi = 34$ mm and 108 mm length; the second multiplier used has a cathode diameter of 38 mm with maximum $\phi = 48$ mm and 190 mm length; neither has a side exposure. Cylindrical focusing with a tapered front window is used for improved axially symmetric combination at the entrance. (R.V.J.)

20347

MEASUREMENT OF SHORT TIME INTERVALS. J. Duclos, R. Van Zurk, S. André, and J. Fleury (Centre d'Études Nucléaires, Grenoble, France). J. phys. radium 21, 385-7(1960) May. (In French)

Two fast coincidence circuits were studied for fast neutron time of flight spectrometry and for short half life measurements: a chronotron able to analyze automatically with a multichannel height analyzer (2.10^{-10} per channel); a differential very fast coincidence circuit with a movable channel. Also a time to height converter derived from the Bell circuit is studied. A short description of these circuits and the performances obtained are given. (auth)

20348

MEASUREMENT OF THE LIFETIME OF EXCITED STATES BY TIME-AMPLITUDE CONVERSION. J. Samuell and A. Sarazin (Institut d'Études Nucléaires, Algiers). J. phys. radium 21, 390-3(1960) May. (In French)

A time to pulse height converter covering the range from 0.1 to 10 ns is described. The resolution for Na^{22} gamma ray annihilation radiation is 0.7 ns. The system has been used to measure the lifetime of the 80 kev gamma transition of I^{131}. (auth)

20349

DETECTOR ARRANGEMENT FOR SCATTERING STUDIES. R. Chaminade, M. Cros, M. Crut, and A. Papineau (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 396-8(1960) May. (In French)

The main characteristics of the detectors and associated electronics used in scattering experiments at 44.4 Mev incident α particle energy are described. The electronics is intended for selection of the kind of particle. (auth)

20350

THE CRYSTAL SPECTROMETER OF THE EL-3 REACTOR. R. Genin, R. Joly, and M. Ribrag (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 473-4 (1960) May. (In French)

The crystal spectrometer used at the EL 3 pile is briefly described. Preliminary measurements on the variation of the ternary fission versus the energy of the incident neutrons are reported. (auth)

20351

MULTIDIMENSIONAL TRANSFER ANALYZERS. A. Pages (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 475-7(1960) May. (In French)

Spectrometric analysis depending on several parameters necessitates a large number of experiments. In order to diminish the working time and to increase the stability and the experimental possibilities, the problem of multidimensional analysis was studied. (auth)

20352

α SCINTILLATION SPECTROMETER WITH Cs(Tl). J. Fleury, P. Perrin, M. Boge, and J. Laugier (Centre d'Études Nucléaires, Grenoble, France and Faculté des Sciences, Grenoble, France). J. phys. radium 21, 480-3 (1960) May. (In French)

In spectrometry with CsI(Tl) crystals the following characteristics have been observed: only one constant (0.40 μsec) for γ rays and electrons and one constant (0.40 μs) for α particles; the light efficiency with electrons is 1,300 ev/photoelectron (400 ev with NaI). The best resolution in α spectrometry is 2.5% with 9 Mev α particles. (auth)

20353

ABSOLUTE β MEASUREMENT BY 4π SCINTILLATION SPECTROMETRY. E. Corompt and R. Bouchez (Centre d'Études Nucléaires, Grenoble, France and Faculté des Sciences, Grenoble, France). J. phys. radium 21, 483-6 (1960) May. (In French)

A 4π β scintillation spectrometer was constructed with two P. M., 53 AVP and two activated polystyrene scintillators operated at $-20°C$. The β spectra of $Sr^{90} + Y^{90}$, S^{35}, and P^{32} are analyzed by the method of the Kurie plot which enables one to reconstitute the spectrum at low energies and to extrapolate the number of soft electrons in the background. Theoretically this method gives an absolute measurement with 1% precision. It can, however, be improved by lowering the threshold, selecting the P. M., by the use of scintillators with a better luminescence yield and by the method of coincidences which reduces the background. (auth)

20354

EFFECTS OF TEMPERATURE ON LIQUID SCINTILLATORS. G. Laustriat and A. Coche (Centre de Recherches Nucléaires, Strasbourg). J. phys. radium 21, 487-9(1960) May. (In French)

The effect of temperature on liquid scintillators when the fluorescence is excited by γ rays or ultraviolet light was examined. Operating, in each case, with various solvents or solutes, an effect of temperature was found at different stages of energy transfer from the solvent to the solute and on the fluorescence of the solute. (auth)

20355

MODIFICATION OF THE PROPERTIES OF MAGNETS PRODUCED BY THE MARGIN EFFECT. R. Belbeoch, P. Bounin, and G. Proca (Faculté des Sciences, Orsay, France). J. phys. radium 21, 489-92(1960) May. (In French)

It is shown that the fringe field of a constant-gap magnet gives nearly the same effect as if the magnet is replaced by a fictitious magnet such that $\int U(z)\,dz$, measured along a line perpendicular to an entrance or an exit face, is the same for both magnets. This result may be generalized to n-type magnets, but with rather more complicated expressions. The Cartan graphical construction is extended to these magnets. (auth)

20356

CHARACTERISTICS OF A SIEGBAHN-SLATIS β SPECTROMETER. P. Depommier, M. Chabre, J. Crançon, and H. Vialettes (Centre d'Études Nucléaires, Grenoble, France and Université, Grenoble, France). J. phys. radium 21, 493-5(1960) May. (In French)

A long lens β ray Siegbahn-Slatis spectrometer has been tested. The best resolution found is 0.5% with Th B. Under normal conditions 3% transmission with 1.5% resolution was obtained. Conversion lines and continuous spectra were studied. The accuracy in the spectrum shape may attain 1%. (auth)

20357

CONSTRUCTION OF A SELF-CONTROLLED WILSON CLOUD CHAMBER WITH VARIABLE PRESSURE (BETWEEN 1 cm Hg and 76 cm Hg) OF A NEW TYPE). T. Yuasa (Laboratoire de Physique Nucléaire, Orsay, France and Faculté des Sciences, Paris). J. phys. radium 21, 495-7(1960) May. (In French)

With a view to studying phenomena concerning charged particles of very short range, a self-triggered cloud chamber with an adjustable pressure between 1 cm Hg and 76 cm Hg was constructed. Low pressure working characteristics of this chamber are given. (auth)

20358

AN INSTRUMENT FOR MEASURING THE ACTIVITY OF RADIOISOTOPES. K. Subrahmanyam (Atomic Energy Establishment, Trombay, India). J. Sci. Ind. Research (India) 19A, 212-15(1960) May. (In English)

An ionization chamber for the rapid measurement of the strength of radioactive sources directly in curies is de-

scribed. The instrument can measure activities from 10 μc to several curies of radium equivalent in the gamma chamber and from 0.5 μc upwards of phosphorus-32 in the beta chamber. (auth)

20359

MEASUREMENTS ON A COLLIMATOR FOR SCINTILLATION COUNTERS. G. Nentwig (VEB Vakutronik, [Dresden]. Kernenergie 3, 14-22(1960) Jan. (In German)

The experimentally determined iso-pulse curves from cylinder, cone, and multichannel collimators are discussed in comparison to calculated curves. The relatively standard curves are drawn to the 364-kev gamma line of I^{131} in consideration of their use in medicine. Using a multichannel collimator, it is shown that the field of the iso-pulse curve changes for gamma rays of higher energy as from Gs^{137} and Co^{60}. (tr-auth)

20360

A 4π COUNTING TUBE FOR ROUTINE DETERMINATIONS OF THE ABSOLUTE DECAY RATE OF β-EMITTERS. H. Schmidt (Institut für Medizin und Biologie, Deutsche Akademie der Wissenschaften, Berlin-Buch). Kernenergie 3, 117-22(1960) Feb. (In German)

The uncoupled 4π counting tube with an ordinary alcohol–argon filling was studied. Its counting characteristics can be improved several times by an electronic quenching circuit. By oscillographic study of the discharge process of the tube and by comparison of the characteristic and counting rate it is shown that the counting tube with methane filling has just as good characteristics. A high vacuum is no longer necessary for filling the tubes. The SKR-06 is used as counting apparatus and high-voltage source. (tr-auth)

20361

OVERLOAD CONTROL AMPLIFIER VA-V-82A. R. Gartner (VEB Vakutronik, Dresden). Kernenergie 3, 209-21(1960) Mar. (In German)

For spectrometric measurements with scintillation counters the broad-band linear amplifier used must meet the special requirement of overload-control. This means that the amplification of pulses within the linear modulation region should be not at all or only slightly influenced by such pulses, which exceed the linear modulation region. The VA-V-82A broad-band linear amplifier, an improvement of the VA-V-82, fills these requirements and is especially suited to scintillation spectrometry. The origin at the overload and its elimination in the VA-V-82-A are discussed. Measurements of the 32-kev x-ray line of the Cs^{137} spectrum with an intense γ background from Co^{60} demonstrate the superiority of the overload control circuit. (tr-auth)

20362

PREPARATION AND INVESTIGATION OF OPTIMAL NEUTRON SCINTILLATORS. H. Abel and V. Bredel (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie 3, 414-21(1960) May. (In German)

A procedure is given for preparation of scintillators for fast and slow neutrons, by which particularly the suitability of commercial phosphors of the Deutschen Demokratischen Republik is proven. A study of neutron scintillators shows that their discrimination even in a relatively strong γ background demonstrates a high efficiency. (tr-auth)

20363

THE DISSOCIATION OF ISOPENTANE IN GEIGER-MÜLLER COUNTING TUBES. K. H. Oertel (VEB Vakutronik, Dresden) and J. Büttner and Ch. Weissmantel (Technische Hochschule, Dresden). Kernenergie 3, 422-4 (1960) May. (In German)

Results are described from a mass spectrometric study of aged counting tubes with isopentane–argon filling and graphite cathodes. The mass spectra show for increasing pulse loading of the counting tube a decrease in intensity of the mass lines for molecules with 3 or more carbon atoms and an increase for molecules with 1 and 2 carbon atoms. Exceptions to this rule can be indicated. The aging of the counting tube is essentially due to production of C_2H_2 and C_2H_4 whose polymerization products affect the cathode. (tr-auth)

20364

A LOW PRESSURE CLOUD CHAMBER WITH PURE WATER VAPOR FILLING. M. Pollermann (Technische Hochschule, Munich). Kerntechnik 2, 185-91(1960) June. (In German)

A low-pressure cloud chamber was developed which with a filling of pure water vapor yields cloud tracks of α particles from which single droplets are detectable. It has a sensitivity duration of 11 msec at an optimum expansion ratio of 1.55. (tr-auth)

20365

AN APPARATUS FOR THE CONTINUOUS MONITORING OF BETA AND GAMMA ACTIVITY OF THE AIR AND OFF-GASES AT VARIOUS SITES. Th. Nielsen (Institutt for Atomenergi, Kjeller, Norway). Kerntechnik 2, 201-2 (1960) June. (In German)

The construction of a device which permits the continuous monitoring of the beta and gamma activity of the air and off-gases at 10 different measurement stations is described. (tr-auth)

20366

THE STATE AND PROSPECTS OF THE DEVELOPMENT OF RADIOLOGICAL PROTECTIVE EQUIPMENT FOR MEDICAL INSTITUTIONS. V. I. Gordon, V. V. Dmokhovskii, and A. F. Rimman. Med. Radiol. 5, No. 5, 22-6(1960) May. (In Russian)

Problems in designing technical devices—radiological protective equipment—conforming to the accepted system of radiological institutions in the USSR are discussed. The specific features of radiological protective equipment, determining the efficacy of its exploitation, are discussed. The authors enumerate the premises necessary in a radiological department and give their characteristics. A conclusion is drawn on the expediency of elaborating a unified complex of protective equipment, ensuring the safety of the personnel. A classification of the existing protective equipment, applicable to the requirements of a unified complex, is presented. A brief review is given of designs of radiological protective equipment, the state of their production, and the prospects of further development of experimental designing. (auth)

20367

DOSIMETRY USING THERMOLUMINESCENCE. H. Stauffer (Universität, Bern). Neue Technik 1, No. 4, 3-9(1959) Aug. (In German)

20368

RESEARCH WORK OF ETH AT WÜRENLINGEN. I. (n,γ) SPECTROSCOPY. W. Wölfli (Physikalisches Institut der ETH, Zurich). Neue Technik 1, No. 7, 15-27(1959) Nov. (In German)

First, there is a description of the (n,γ) mechanism and its difference from the simultaneously formed radioactivity. The examination of the electromagnetic radiation resulting from the (n,γ) reaction is only possible by means of secondary processes, occurring when high energetic gamma-quanta are passing the matter. After a description of the three most important interactions, follows a summary of the gamma measuring methods. Finally, as

an example of a magnetic gamma-ray spectrometer, a pair spectrometer is described in detail and how (n,γ) measurements on a reactor are practically handled is demonstrated. (auth)

20369

ELECTRONIC INSTRUMENTS OF HIGH STABILITY FOR REGISTRATION OF THE NUCLEON COMPONENTS OF COSMIC RAYS. W. Lotz and A. Sittkus (Universität, Freiburg I. B.). Nuclear Instr. & Methods 7, 237-44 (1960) June. (In German)

A description is given of a full set of electronic instruments for a Neutron Intensity Monitor. The obtained stability in time for 10^4h amounts to 6% for the sensitivity of the amplifier and discriminator; 2% for the dead time; 0.5% for 300 V d-c, 0.25% for high voltage. The probable error of the annual mean of the neutron intensity may be reduced to 0.1%. A ratemeter with logarithmic scale was constructed by using a voltage dependent resistor. (auth)

20370

THE ELECTROMAGNETIC ISOTOPE SEPARATOR IN PRETORIA. W. E. Frahn, W. L. Rautenbach, and L. Wåhlin (Council for Scientific and Industrial Research, Pretoria). Nuclear Instr. & Methods 7, 253-68(1960) June. (In English)

The electromagnetic isotope separator in Pretoria is described. This machine is a laboratory separator of the "Scandinavian" type using a 90° magnetic sector field of mean radius 180 cm, a maximum acceleration voltage of 80 kv, an electrostatic lens system with two-directional focusing, and magnetic arc sources with end extraction. Special design features make the instrument suitable for the performance of certain nuclear experiments. Particular attention was given to ion beam formation in the separator in order to obtain optimum resolving power and good transmission at high ion currents. (auth)

20371

IMPROVEMENTS OF THE COLLECTOR SYSTEM FOR A LABORATORY ISOTOPE SEPARATOR. L. Wåhlin (Council for Scientific and Industrial Research, Pretoria). Nuclear Instr. & Methods 7, 269-73(1960) June. (In English)

An improved beam position stabilizer, a new line scanning device, and an automatic recording system are described. This equipment is used in the electromagnetic isotope separator in the Nuclear Physics Division of the National Physical Research Laboratory in Pretoria. (auth)

20372

THE SPECTRAL SENSIBILITY OF A MAGNETIC GAMMA-SPECTROMETER IN A PHOTOELECTRIC METHOD. E. P. Grigor'ev (Grigoryev) and A. V. Zolotavin (Leningrad Univ.). Nuclear Instr. & Methods 7, 289-92(1960) June. (In English)

It is shown that by using a cylindrically symmetric source one can compensate the influence of the angular distribution of photoelectrons on the determination of relative intensities of γ rays in measurements with the help of a transversal magnetic spectrometer. (auth)

20373

A THIN LIQUID HYDROGEN OR DEUTERIUM TARGET. E. H. Bellamy, W. R. Hogg, and D. Miller (Glasgow Univ.). Nuclear Instr. & Methods 7, 293-6(1960) June. (In English)

The construction and performance of a low background double-walled flat liquid hydrogen or deuterium target of precisely known thickness is described. (auth)

20374

ON THE AUTOMATIC CONTROL OF SCINTILLATION SPECTROMETERS. H. W. Taylor and R. McPherson (Queen's Univ., Kingston, Can.). Nuclear Instr. & Methods 7, 315-19(1960) June. (In English)

A simple control circuit is described which permits the automatic control of a scintillation coincidence spectrometer used for directional correlation studies and coincidence measurements. Automatic sequential pulse height analysis is obtained by coupling to the control unit a 100-position stepper which advances the bias on a single channel analyzer. (auth)

20375

A MULTIPLE EVENT ANALYSER. W. G. Gore (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods 7, 320-4(1960) June. (In English)

A circuit is described that produces an output pulse, the height of which is proportional to the number of input pulses received in a given time interval after an input gate pulse. This circuit, when used with a pulse height analyzer, enables the distribution of the number of pulses per burst to be analyzed. The maximum number of pulses per burst that can be counted is ten. (auth)

20376

A HIGHLY ACCURATE CONTINUOUSLY VARIABLE FREQUENCY CONTROL SYSTEM. C. H. Vincent (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods 7, 325-37(1960) June. (In English)

A method is described for controlling the frequency of an oscillator with crystal accuracy and at the same time permitting effectively continuous adjustment of the frequency required. A selected multiple of the oscillator period is obtained by counting the oscillator cycles with a fast binary scaler followed by a special scaler with a widely variable scaling factor. The resulting time interval is accurately compared, in a suitable circuit, with a fixed time interval, derived from a crystal oscillator. A signal is thus obtained which drives a differential motor system in the appropriate direction to correct the adjustment of the oscillator tuning condenser. (auth)

20377

ON THE GRAIN DENSITY IN ILFORD G-5 EMULSION OF SINGLY CHARGED RELATIVISTIC PARTICLES. B. Jongejans (Universiteit, Amsterdam). Nuovo cimento (10) 16, 625-43(1960) May 16. (In English)

The grain density in nuclear emulsion was determined as a function of the value of $(\gamma-1)$ of the particle producing the track. Values of the parameter $(\gamma-1)$ between 0.8 and 10^3 were taken into consideration. The number of blobs per unit length was directly determined. Transformation of blob density into grain density was carried out. Care was taken to relate all determinations to each other, a constant scale of reference being found in pions of momentum between 5.2 and 5.7 Bev/c. The results are in agreement with the theory given by Sternheimer. The value 501 ± 8 ev was used for the ionization potential of AgBr in the present work, taken from Barkas. The cutoff energy consequently determined is 100 kev. It is shown that the results are not very sensitive to this last value. (auth)

20378

SYMPOSIUM ON SOLID STATE CONDUCTIVITY. II. RECENT EXPERIMENTS WITH CRYSTAL COUNTERS. F. C. Champion (King's Coll., London). Phys. in Med. Biol. 4, 334-8(1960) Apr.

The performance of diamonds as conduction counters is discussed. The main disadvantages are the continuous pulse height distribution, even with monoenergetic par-

ticles, and polarization phenomena which tend to reduce the pulse heights, although the latter disadvantage can be overcome in certain conditions. The correlation between the performance of diamonds as conduction counters and as scintillation counters is discussed. Silicon carbide and magnesium oxide are also considered briefly. (auth)

20379

SYMPOSIUM ON SOLID STATE CONDUCTIVITY. IV. SOLID STATE RADIATION DETECTORS, WITH PARTICULAR REFERENCE TO LOW DOSE RATES. John F. Fowler and Edward H. Grant (King's Coll. Hospital, London). Phys. in Med. Biol. 4, 344-57(1960) Apr.

The use of single crystals of photoconductor was investigated at gamma dose rates of 1 to 300 r/min for supervoltage beam measurements, 10 to 300 r/hr for intracavitary probes, and at very low dose rates of the order of 1 mr/hr for radiation protection or for the detection of isotopes in the human body. Results are presented of measurements on CdS and CdSe crystals from various industrial sources. It is possible to obtain crystals which pass 0.1 to 1 μA per r/min (Co^{60}) with a dark current some 3 orders of magnitude smaller; a few have been tested which give up to 40 μA per r/min, but the more sensitive crystals are more difficult to obtain. Results of measurements on single crystals have shown that linearity with dose rate, reasonably short time constants, and small dependence on temperature are possible with CdS, but CdSe has not yet been found to be so good in the two last-mentioned properties. Radium dose rates of 1.3 to 2 mr/hr have been detected to an accuracy of about 20% within 5 to 10 min of beginning the exposure. Such dose rates would enable the distribution of a few tens of microcuries of I^{131} to be displayed, by an array of single crystals of CdS, and the methods of achieving this are discussed. Present photoconductors show considerable promise for these and other applications, with little improvement in properties but with supplies made more readily available. (auth)

20380

SYMPOSIUM ON SOLID STATE CONDUCTIVITY. VI. A NOTE ON THE PERFORMANCE OF INTRACAVITARY CdS PROBES IN SUPERVOLTAGE THERAPY. D. E. A. Jones (Mount Vernon Hospital, Northwood, Middx., Eng.). Phys. in Med. Biol. 4, 370-2(1960) Apr.

A simple photoconductive crystal dosimeter for x and gamma rays is described. The induced current is linear with dose rate over the range 0.3 to 150 r/min, and with a crystal cover of 0.8 mm gold the response is sufficiently independent of radiation quality for use in Co^{60} therapy. (auth)

20381

THE ANNIHILATION COINCIDENCE METHOD OF LOCALIZING POSITRON-EMITTING ISOTOPES, AND A COMPARISON WITH PARALLEL COUNTING. N. A. Dyson (Hammersmith Hospital, London). Phys. in Med. Biol. 4, 376-90(1960) Apr.

The localization of positron-emitting radioisotopes by the detection of annihilation coincidences was studied, with particular reference to the use of oxygen-15 in the study of lung function. High coincidence counting rates are needed, and it is important to minimize and then correct for the random coincidences which would otherwise spoil the spatial resolution, and falsify the measurements of the steady fall of oxygen-15 activity in the lungs during breath-holding. The problem is accentuated by the presence of large activities in the lung surrounding the region under investigation, especially if the ventilation of this selected region is defective. The response of the counting system as a function of position was studied. Isocount curves in air and in a medium were obtained and their main features are discussed. The use of collimation, and of pulse-height analysis to select the photoelectric peak of the scintillation spectrum are dealt with; their effect on the random coincidence counting rate was investigated, and it is concluded that in the present type of application the selection of the photoelectric peak is usually a disadvantage. An alternative counting method, in which the two counters in a pair are simply connected together, was investigated and is in use. It gives higher counting rates but poorer resolution, so the two methods are complementary. The ability to respond solely to radiation arising from within a defined region is an important property of any counting system, and the numerical method integrated response has been devised to study this. The extent to which the present study is relevant to other positron emitters is briefly considered. (auth)

20382

VELOCITY DEPENDENCE OF THE BUBBLE DENSITY FOR CHARGED PARTICLE TRACKS IN LIQUID HYDROGEN. V. P. Kenney (Brookhaven National Lab., Upton, N. Y. and Univ. of Kentucky, Lexington). Phys. Rev. 119, 432-5(1960) July 1.

Bubble densities of tracks of 635-Mev/c protons and pions in a liquid hydrogen bubble chamber operated at 26.5°K, 62 psig were determined from measurements of the distribution in spacing of the individual bubbles. The velocity dependence of the bubble density was obtained by fitting the bubble densities observed to the expression $m = A/\beta^b$ by the least-squares method, yielding the values $A = 8.64$ bubbles/cm, and exponent $b = 1.935 \pm 0.077$. The constant A is a function of the temperature of the liquid hydrogen, varying ~30% per 0.1°K. If the number of bubbles per unit track length observed is correlated with the rate of delta-ray formation, it would appear that an energy of the order of 400 ev is necessary for bubble nucleation in liquid hydrogen. (auth)

20383

RECALIBRATION OF THE NBS CARBON-14 STANDARD BY GEIGER-MÜLLER AND PROPORTIONAL GAS COUNTING. W. B. Mann, H. H. Seliger, W. F. Marlow, and R. W. Medlock (National Bureau of Standards, Washington, D. C.). Rev. Sci. Instr. 31, 690-6(1960) July.

Compensated internal gas counters were constructed for the recalibration of the National Bureau of Standards carbon-14 solution standards. Satisfactory agreement was obtained by counting in both the proportional and Geiger regions. (auth)

20384

CLOSED CIRCUIT LIQUID HYDROGEN REFRIGERATION SYSTEM. D. B. Chelton, J. W. Dean, and B. W. Birmingham (National Bureau of Standards, Boulder, Colo.). Rev. Sci. Instr. 31, 712-16(1960) July.

A liquid hydrogen bubble chamber was maintained at 27°K with an automatically controlled closed circuit hydrogen refrigeration system of 300-w capacity. The system was used continuously for more than 2000 hours on a 15-in. bubble chamber at the Lawrence Radiation Laboratory. The design uses commercially available heat exchanger tubing and controls. Actual performance is compared to predicted performance for design operating conditions. The refrigeration system is sufficiently flexible to be used on other experimental apparatus requiring refrigeration at liquid hydrogen temperatures. (auth)

20385

HIGH SENSITIVITY MASS SPECTROMETER LEAK DETECTOR. N. R. Daly (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Rev. Sci. Instr. 31, 720-3(1960) July.

A new type of mass spectrometer ion detector is described and some of its applications discussed. A positive ion entering the detector is accelerated onto a thin metal foil where it releases secondary electrons, which are in turn accelerated onto an organic scintillator viewed by a photomultiplier; this measures the total ion beam. Those ions which penetrate the foil sufficiently release secondary electrons from the back of the foil, and these are detected in a similar way. The transmission properties for many light ions were investigated and it has been found that the foils have high transmission for helium ions and high rejection for "air" ions. The results obtained can be applied to improving the sensitivity of leak detectors, appearance potential measurements, and the analysis of small quantities of deuterium in hydrogen. (auth)

20386

PRECISE AUTOMATIC INEXPENSIVE BURET READER. J. Farquharson (Oak Ridge Gaseous Diffusion Plant, Tenn.). Rev. Sci. Instr. 31, 723-5(1960) July.

An instrument was developed to find automatically the level of a colorless liquid in a glass tube and to indicate the volume on a digital register. The instrument is applied to volumetric measurements required in a chemical titration. The first model has a range of 40 ml, a precision of ±0.02 ml on a single determination (95% confidence level), and a bias of 0.1%. A photocell detector with a cable and drum elevating and measuring mechanical system is employed. (auth)

20387

ANALYSIS OF GAS EVOLUTION FROM A TITANIUM HYDRIDE GAS GENERATOR. Leonard Levine and David Lichtman (Sperry Gyroscope Co., Great Neck, N. Y.). Rev. Sci. Instr. 31, 731-3(1960) July.

Gas analysis on a metal bakable high vacuum system is carried out with the aid of an omegatron mass spectrometer to determine the purity of hydrogen evolved from a titanium hydride source. Curves of the ion current versus mass-to-charge ratio are shown for the system, before, during, and after bakeout as well as during the running of the generator. The generator, after moderate processing, is found to yield hydrogen gas that is 97% pure. The impurities found are water vapor, methane, and ethane. An explanation for the presence of these impurities is offered. (auth)

20388

OPTICAL METHODS FOR NEGATIVE ION STUDIES. Stephen J. Smith and Lewis M. Branscomb (National Bureau of Standards, Washington, D. C.). Rev. Sci. Instr. 31, 733-47(1960) July.

A high vacuum crossed-beam apparatus for the study of photodetachment of electrons from negative ions is described, with emphasis on (1) the optical system which transmits a filtered high intensity photon beam, (2) a high transmission mass selector and associated ion optics, and (3) the sensitive a-c preamplifier, amplifier, and phase sensitive detector used for measuring the photodetached electron current. The methods used for calibrating and operating the apparatus are discussed. (auth)

20389

SIMPLE METHOD FOR CALIBRATION OF MAGNETIC ANALYZERS FOR NUCLEAR ACCELERATORS. E. W. Hamburger (Univ. of Pittsburgh). Rev. Sci. Instr. 31, 777-8(1960) July.

A method is presented for determining particle energies with a magnetic analyzer in the case where the calibration function is not known. The method is based on the fact that the calibration function is not needed to determine whether two groups of particles of equal charge have the same momentum; for reactions 1 and 2 produced in the target by a beam of constant energy E_1, E_1 can be determined accurately if p_1-p_2 (momentum difference of outgoing particles of reactions 1 and 2) is measured approximately. This method can be used for calibration in the high-energy region where no α particle sources are available and for the determination of Q values. The (d,d) and (d,t) reactions of Mg^{26} are considered as an example; E_1 is found to be 15.016 Mev, with an over-all error of ~45 kev. (D.L.C.)

20390

AUTOMATIC ION CHAMBER CORRECTION FOR TEMPERATURE AND PRESSURE. E. G. Bylander and J. R. Gardner (Convair, Ft. Worth, Tex.). Rev. Sci. Instr. 31, 778-9(1960) July.

The output from sealed 50- and 4-cc ion chambers was found to increase 5% and 10 to 15% for temperature changes from 25 to 50°C and 25 to 80°C, and the change is ascribed to outgassing of the graphite electrodes. In order to circumvent pressure and temperature effects, a computer was constructed for the multiplication of the detector output by correction factors, incorporating thermocouples and potentiometers. A prototype gave 3% precision and should give 1% precision under more careful construction. (D.L.C.)

20391

ON-STREAM RADIOACTIVITY MONITOR FOR GAS-HANDLING SYSTEMS. G. L. Grandy and R. C. Koch (Nuclear Science and Engineering Corp., Pittsburgh). Rev. Sci. Instr. 31, 786(1960) July.

A radioactivity-monitoring system was developed for the continuous monitoring of dynamic gas systems. In the modification for β radiations, the detector head consists of a gas-flow chamber, a plastic scintillation head, and associated electronic equipment (standard 2-inch photomultiplier, etc.). For measurement of γ radiations, a NaI(Tl) scintillator is substituted for the plastic scintillator. This system was used for measuring Kr^{85} and Xe^{133} in gas tracer experiments. (D.L.C.)

20392

COMPACT PALLADIUM DIFFUSION LEAK FOR HYDROGEN. Lowell A. Noble, William H. Sain, and Robert K. Waits (Eitel-McCullough, Inc., San Bruno, Calif.). Rev. Sci. Instr. 31, 789-90(1960) July.

A Pd diffusion leak for H_2 purification was constructed having small size and low current operation. It consists of a Pd thimble (0.25-in. diam, 0.005-in. wall thickness) with a 0.103-in. diam spiral of 0.0085-in. thoriated W wire in its center as a heater. Typical H_2 flow rates are 16 and 21 atm-cm^3/min at 20 and 26 w, respectively; thermocouple measurements indicate a Pd temperature of 270°C at 20 w. Several such leak tubes were operated intermittently at 20 w for >300 hr; no failures occurred. A similar leak tube was made from Ni; flow rate was 1.5 atm-cm^3/min at 40 w. (D.L.C.)

20393

LINEARIZING THE BOTTOM CHANNELS OF THE 256-CHANNEL PULSE-HEIGHT ANALYZER. Richard M. Rodrigues, Harry I. West, Jr., and Joseph J. Ronchetto, Jr. (Univ. of California, Livermore). Rev. Sci. Instr. 31, 790-1(1960) July.

The nonlinearity of the Argonne-type 256-channel pulse height analyzer below channel ten, due to the ramp circuit of the analog-to-digital converter, is corrected in the following way: Instead of redesigning the ramp circuit, the pulses of the 2-Mc address pulse train occurring during ramp nonlinearity are gated out. The gating pulse is derived from the screen of a phantastron, which is triggered by the toggle 2 turned on by the first 2-Mc train pulse. Since the circuit is set to gate out 16 pulses, a count must consist initially of a pulse train of 26 pulses in order to get into channel ten. The method has the disadvantage of increasing the analyzer dead time (~9 μsec), but it enables the operator to use the bottom channels. (D.L.C.)

20394

HIGH VACUUM EVAPORATOR FOR RADIOACTIVE MATERIALS. Hans Widmer and Jordan Kirsch (Columbia Univ., New York). Rev. Sci. Instr. 31, 791-3(1960) July.

A high-vacuum evaporator was built for the deposition of radioactive Ge on Ge substrates for self-diffusion studies and consists of a crucible made out of spectroscopic grade graphite surrounded by a W heater and two Mo radiation shields; the whole is contained in a quartz bell jar attached to a flange and connections to cold traps. The lower 10 to 20 cm of the bell jar is immersed in liquid N_2 during evaporation, serving as a cold trap, and the evaporator construction permits effective precautions against radiation hazards. The graphite crucible can be outgassed at 300 to 400°C above the evaporating temperature (1200°C for Ge) and then charged in vacuum. (D.L.C.)

20395

KERNPHYSIKALISCHE MESSMETHODEN. Buchreihe der Atomkernenergie Band 3. (Measurement Methods of Nuclear Physics. Atomic Energy Book Series, Volume 3). Werner Braunbek. Munich, Verlag Karl Thieming, 1960. 108p. DM 5.80.

A survey is made of the measurement methods used in the field of nuclear physics. The topics discussed are classification of measurement methods, mass spectrographs, measurement of nuclear moments, calorimetric and charge measurements, the ionization chamber, activation measurement, dosimeter, and decay constants, measurement of scattering, absorption, and range, spectrometry with nuclear radiation, counting tubes, scintillation and Cherenkov counters, coincidence methods, cloud and bubble chambers, and nuclear emulsions. (J.S.R.)

20396

PHOTO-ELECTRONIC IMAGE DEVICES. Proceedings of a Symposium Held at London, September 3-5, 1958. J. D. McGee and W. L. Wilcock, eds. Advances in Electronics and Electron Physics. Volume XII. New York, Academic Press, 1960. 407p. $12.00.

Thirty papers presented at the Symposium on Image Tubes and Related Services held at London, September 3 to 5, 1958, are collected in this volume. In addition to reports on their application in television and astronomy a large part of the symposium was devoted to reports of the application of photo-electronic image devices to the luminescent particle track chamber. Separate abstracts have been prepared for three papers which are especially pertinent to nuclear science. (M.C.G.)

20397

IMAGE TUBES IN NUCLEAR PHYSICS. P. E. Condon (Princeton Univ., N. J.). p.123-34 of "Photo-Electronic Image Devices. Proceedings of a Symposium Held at London, September 3-5, 1958." J. D. McGee and W. L. Wilcock, eds. Advances in Electronics and Electron Physics. Volume XII. New York, Academic Press, 1960.

One method of seeing tracks of charged particles, requiring electronic image intensifiers of high gain, was investigated. The sensitive region was built-up of small-diameter fibers of scintillation plastic. When a charged particle passed through the stack, it produced light only in those fibers which it traversed. Some of the light produced was trapped by total internal reflection and piped to the end of the polystyrene fiber. It was determined that an over-all light gain of at least 10^4 would be needed from the ends of the fibers to the film. To achieve this gain, several two-stage RCA image intensifier tubes coupled together in a light amplifier chain were used. One method used to measure gain was a 5-in. diameter photomultiplier placed at varying distances from the anode. In the second method, a specially shaped lucite light pipe, attached to a 2-in. diameter photomultiplier, was placed in mechanical contact with the anode window. Several methods were considered for coupling the intensifier tubes: a fast lens or mirror system, glass fiber bundles, and the use of thin windows for both the input and output of the image tubes. Another problem investigated was that of noise and signal-to-noise ratio. The tubes were too noisy when operated at the recommended voltages, but by reducing the voltage, the noise was reduced, while still maintaining useful gain. (M.C.G.)

20398

AMPLIFICATION OF TRANSIENT IMAGES IN HIGH-GAIN PHOTOCATHODE-PHOSPHOR IMAGE INTENSIFIER SYSTEMS. Arthur Roberts (Univ. of Rochester, N. Y.). p.135-52 of "Photo-Electronic Image Devices. Proceedings of a Symposium Held at London, September 3-5, 1958." J. D. McGee and W. L. Wilcock, eds. Advances in Electronics and Electron Physics. Volume XII. New York, Academic Press, 1960.

The amplification of transient light signals in cascade and regenerative photocathode—phosphor image intensifier systems was studied. The application of internal regeneration to channeled image intensifiers was also investigated. In the regenerative channeled image intensifier, the internal light feed-back from the phosphor direct to the cathode was used to provide a loop gain of more than one, with consequent exponential growth. Because of the channeling there was no loss in resolution. A study of a single simulated channel was made, using an RCAC-73435 shutter-grid image intensifier tube. Results indicated that the build-up period depended upon loop gain. It was possible to vary decay time of the cathode current. Loop gains as high as 6 were possible, even with relatively inefficient optical coupling. (M.C.G.)

20399

THE REGENERATIVE IMAGE INTENSIFIER AND ITS APPLICATION TO THE LUMINESCENT CHAMBER. Martin L. Perl and Lawrence W. Jones (Univ. of Michigan, Ann Arbor). p.153-82 of "Photo-Electronic Image Devices. Proceedings of a Symposium Held at London, September 3-5, 1958." J. D. McGee and W. L. Wilcock, eds. Advances in Electronics and Electron Physics. Volume XII. New York, Academic Press, 1960.

The regenerative image intensifier and its application to the homogeneous luminescent chamber were studied. Unactivated cesium iodide cooled to liquid nitrogen temperatures was found to be the best used in the study. About half the deposited energy in cesium iodide was converted into usable light. Additional energy was introduced from external sources into the chamber and converted into usable light in a region localized about the path of the charged particle. Regenerative image intensifiers of gain 10^4 to 10^8

were considered. Only one or two stages of electronic amplification combined with an image preserving optical system to feed back the light of the output phosphor to the input photocathode were needed. The resolution of the feedback optical system was 20 to 40 line pairs per mm. Results indicated that the noise produced would not prevent track identification. Studies were made of registered, nonregistered, "flip-flop," and forced-registry regenerative image intensifiers. Their efficiencies in applications to luminescent chambers were compared. (M.C.G.)

20400

MEASUREMENT OF DENSITY OF URANIUM METAL BY RADIATION ABSORPTION. J. P. Scheuer (General Electric Co., Cincinnati) and P. R. Morris (National Lead Co. of Ohio, Cincinnati). p.169-74 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

Customary density measurements are made by hydrostatic weighing techniques in which the sample is weighed in two media of known density. This method is not readily applicable to samples weighing in excess of several hundred grams. In comparison, radiation-absorption measurement is readily adaptable to large samples, and the number of samples which may be examined per unit time is greatly increased. A description is given of the Ohmart radiation-absorption instrument used in density measurements. The results, corrected for diameter effect, averaged 0.0046 g/cc higher than those obtained by hydrostatic weighing of the whole sample. The instrument has a tendency to drift, necessitating frequent standardization, sometimes at less than half-hour intervals. This drift is thought to be associated with contact potentials and leakage paths in connectors. An estimation of the order of magnitude of these effects is made. (B.O.G.)

20401

NICKEL THICKNESS GAGE. Louis H. Cook, Jr. (E. I. du Pont de Nemours & Co., Aiken, S. C.). p.225-30 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The thickness of a nickel film can be determined by measuring the force required to pull a small magnet free of the surface. The magnetic properties of nickel suggested that a reluctance technique could be used to determine the thickness of the nickel. The thickness gage is described and the operational characteristics are discussed. Schematic diagrams of the amplifier and gage are included. (B.O.G.)

20402

A HIGH PRECISION DENSITY TIMES THICKNESS GAGE. Grover M. Taylor (Los Alamos Scientific Lab., N. Mex.). p.231-7 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

A discussion is given of the general design considerations of the DXT system, some applications of the gage and of related systems, the experimental procedures used. and the data obtained. Details of the design and pertinent formulas are included. The gage measures the transmission of gamma rays from Co^{60} through materials under examination. Because of the nature of the absorption of high-energy radiation, the variations in transmission can be evaluated to give precise information about the uniformity of the materials in terms of the product of density and thickness. (B.O.G.)

20403

A RECORDING X-RAY PHOTOMETER. W. R. Plant (General Electric Co., Schenectady, N. Y.). p.358-65 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The construction, operation, and calibration of an x-ray photometer are described. The instrument was developed to determine the fuel distribution and total content in a uranium oxide dispersion element. The fuel element core consisted of pelletized uranium oxide dispersed in a matrix of stainless steel. The photometer is an x-ray absorption device in which the fuel element is compared to a known concentration by means of a calibration curve. (B.O.G.)

20404

IMPROVEMENTS IN OR RELATING TO GEIGER-MUELLER COUNTERS. (to Philips Electrical Industries, Ltd.). British Patent 836,190. June 1, 1960.

An anti-coincidence arrangement of a Geiger-Mueller counter is described in which there is only one guard counter whose electrodes are two concentric hollow hemispheres, the smaller one being fitted inside the other; the counter proper and the sample to be measured are inserted inside the smaller hemisphere. The guard electrodes are made from ferrochromium, and the space between the electrodes is filled with an Ar-Cl_2 mixture (Cl_2 concentration >0.001%). The advantages of the above arrangement over conventional many-guard counter arrangements are: the satisfactory operation of the anti-coincidence can be checked in a short time; the spherical shape gives a reduced volume and weight; because of the spherical shape, the field gradient between the guard electrodes is kept at a minimum; and oblique as well as vertical cosmic radiation is canceled out. (D.L.C.)

20405

IMPROVEMENTS IN OR RELATING TO SCINTILLATION SCREENS. Isaac Alan Mossop and Francis Graham Brightman (to United Kingdom Atomic Energy Authority). British Patent 836,404. June 1, 1960.

A process is described for the preparation of scintillation screens. The process consists of treating the surface of a light-transmitting body with a liquid coating, drying to the tacky state, adding the solid phosphor to the coating in the tacky state, heating until the phosphor impregnates itself, and cooling to the solid state. Suitable light-transmitting bodies are glass, methyl methacrylate, and polystyrene. Suitable coating materials include silicone resins in solution in toluene. The most suitable phosphor material for alpha particle detection is zinc sulfide. (W.L.H.)

20406

IMPROVEMENTS IN TIME OF FLIGHT MEASUREMENT NEUTRON SPECTROMETERS. (to Commissariat à l'Énergie Atomique). British Patent 836,490. June 1, 1960.

An improved time-of-flight neutron spectrometer is described in which the conventional electric motor for driving the rotor is replaced with a hydraulic turbine using the same liquid that lubricates the moving parts of the spectrometer. The advantages of such a replacement are that the heavy rotor can be driven for weeks at a time at 15,000

rpm, that possible breakdown due to electric circuit failures are eliminated, and that the slight vacuum increases the power of the turbine. (D.L.C.)

20407

IMPROVEMENTS IN OR RELATING TO ION SOURCES FOR MASS SPECTROMETERS. Eric John Robbins and James Alan McKnight (to United Kingdom Atomic Energy Authority). British Patent 837,140. June 9, 1960.

An improved ion source is presented for the mass spectrometric analysis of gaseous samples such as UF_6; by its use, the instability of the ion beams and the memory effect noted after UF_6 analysis are reduced, the latter by a typical factor of 6. The ion source has the usual cathode, anode, electrode, and hole through which the gaseous sample is fed into the ionizing electron beam, but the electrode has apertures to reduce its surface area and the hole is small, e.g., 0.04-in. diam. compared with an electron beam channel width of 0.125 in., thereby forming a molecular flow of the gas. The effect of these alterations is to reduce corrosion and adherence of contaminants to the electrode. (D.L.C.)

20408

IMPROVEMENTS IN AND RELATING TO APPARATUS COMPRISING ELECTRON-OPTICAL IMAGE CONVERTER TUBES. George Harold Lunn (to Atomic Weapons Research Establishment) and Robert Arthur Chippendale (to Mullard Research Labs.). British Patent 839,365. June 29, 1960.

An electron-optical image converter tube apparatus was invented with the image broken up in such a way that a plurality of photographs of the pictured phenomenon can be obtained, each corresponding to different times. This breaking-up is accomplished by a mask inserted between the cathode face and the photoemissive layer inside the tube; this mask may have apertures in the form of parallel lines or dots arranged in a rectangular pattern. In a practical pattern, 0.001-inch squares were arranged 0.009 inch apart, giving ~10,000 squares/in.^{2} By means of a circuit arrangement and deflector coils, the electron image is deflected with time to form an interlaced image on the anode, which is then photographed. This photograph may be scanned to give photographs taken at different times. (D.L.C.)

20409

PROBE FOR A SCINTILLOMETER. Archimiro Caha and Vladimir Prokes. British Patent 839,511. June 29, 1960.

A probe for a scintillometer was invented for the measurement of radiations in body cavities and other small places, e.g., molds. It consists of two parts, one of which contains a luminescent crystal at one end and a light conductor divided into two long thin pieces held apart by blocks. The other part, attached to the other end of the first part, contains a photomultiplier and an electromagnetically operated shutter which admits light from one piece of the sectioned light conductor only, thereby permitting compensation of measurements to be made. Light-tight casing and connections eliminate the effect of light conductor luminescence and the direct effect of the radiation on the photomultiplier. (D.L.C.)

20410

RADIANT ENERGY SENSITIVE APPARATUS. (to Radio Corp. of America). British Patent 840,095. July 6, 1960.

A radiant energy sensitive apparatus is described. The apparatus includes an alternating current utilization device and a radiation sensitive body which varies its impedance in response to radiant energy excitation. The radiation sensitive body has a number of individual electrical contacts connected to elemental sections. Means are provided for applying across the radiation sensitive device alternatively a voltage in one polarity to half of the contacts and a voltage in opposite polarity to the remaining ones. (W.L.H.)

20411

IMPROVEMENTS IN OR RELATING TO ELECTRIC CONDENSERS. (to United Kingdom Atomic Energy Authority). British Patent 840,313. July 6, 1960.

A condenser consisting of a rolled sandwich of metal foils and oil-impregnated dielectric material, with the rolled sandwich surrounded by a protective casing, is presented. The condenser is reliable in the temperature range 0 to 80°C. (W.L.H.)

Materials Testing

20412

SYMPOSIUM ON NONDESTRUCTIVE TESTS IN THE FIELD OF NUCLEAR ENERGY. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223. Philadelphia, American Society for Testing Materials, 1958. 402p. $10.00.

Included are papers presented at the symposium which evolved from the meetings of an informal committee of AEC contractors dealing with the general subject of nondestructive testing. The objectives of the symposium were to disseminate fifteen years of research and development on nondestructive testing in the nuclear field and to reach people interested in nuclear and industrial applications. Forty-one papers are included; separate abstracts have been prepared for 37. Abstracts of the remaining 4 appeared previously in NSA. (B.O.G.)

20413

NONDESTRUCTIVE TESTING IN THE NUCLEAR ENERGY FIELD. Stuart McLain (Argonne National Lab., Ill.). p.3-12 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The needs for nondestructive testing in the nuclear field, the history of developments which have taken place, and an indication of the present status of development programs are reviewed. Reference is made to the use of eddy currents, ultrasonics, various types of radiations, and other phenomena to check components of nuclear plants. (B.O.G.)

20414

INTRODUCTION TO EDDY CURRENT METHODS AND TECHNIQUES. H. L. Libby (General Electric Co., Richland, Wash.). p.13-28 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The eddy current testing is applicable to the examination of electrically conducting specimens for irregularities in structure and composition. Eddy current tests are generally nondestructive and are adaptable to 100% inspection. Applications include metal sorting, detection of cracks transverse to current flow, determination of electrical conductivity, detection of voids and inclusions, and thickness measurements of plate, tubing, plate cladding, and depth of nonconducting films on electrically conducting bases. This method indirectly evaluates the characteristics of the test specimen, and care must be taken to prove

the correlation between the measured quantities and the structural or serviceability characteristics. (B.O.G.)

20415

SURVEY OF ULTRASONIC METHODS AND TECHNIQUES. S. A. Wenk (Univ. of California, Livermore). p.29-43 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

A background is given of basic information in the field of ultrasonic nondestructive testing. The presentation is slanted toward those basic methods and techniques adapted to nuclear materials and components. The discussion is divided according to fundamental characteristics of ultrasound, basic equipment, and basic methods and techniques. It is emphasized that any nondestructive test method is only as effective and reliable as the operator. (B.O.G.)

20416

SURVEY OF RADIATION TECHNIQUES. Gerold H. Tenney (Los Alamos Scientific Lab., N. Mex.). p.44-61 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The utilization of radiation in the field of nondestructive testing is discussed. The four kinds of radiation used in the study of physical characteristics are x rays, alpha particles, beta particles, and gamma rays. Sources for and characteristics of these radiations are discussed. Applications in flaw detectors, liquid level indicators, wear an tear studies in the metal industry, gages, microscopy, and diffraction analysis are described. (B.O.G.)

20417

PRODUCTION INSPECTION OF PIPE AND TUBING BY THE IMMERSED ULTRASONIC METHOD. R. B. Oliver, R. W. McClung, and J. K. White (Oak Ridge National Lab., Tenn.). p.62-79 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The pulse-echo ultrasonic methods were selected as promising the earliest solution to this inspection problem with the minimum requirement for instrument development. The design criteria for the critical inspection included instrument characteristics compatible with thin sections of small tubing and mechanical designs flexible enough for adaptation to large diameter pipe. The basic instrument can be used for either contact or immersed scanning. The inspection procedures and the three commonly used methods of data presentation are discussed. (B.O.G.)

20418

AN EDDY CURRENT TEST FOR CAPILLARY TUBING. W. R. Plant and C. Mannal (General Electric Co., Schenectady, N. Y.). p.80-7 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

A study was undertaken of the design considerations leading to a reasonably simple, and at the same time highly sensitive and dependable, eddy current test for capillary tubing. The developmental problems encountered in the study are discussed. A comprehensive program of destructive examination revealed that the test invariably detected cracks as deep as 0.0025 in. It is believed that the apparatus ideally solves the problem for which it was designed and that it offers a satisfactory method of evaluating quality of small, high-resistance tubing typified by the type 347 and type 304 analyses. (B.O.G.)

20419

INSPECTION OF SMALL DIAMETER TUBING BY EDDY CURRENT METHODS. J. W. Allen and R. B. Oliver (Oak Ridge National Lab., Tenn.). p.88-111 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The method of eddy current inspection consists of inducing currents into metal parts to be inspected by bringing it into the electromagnetic field of a coil supplied with a-c. The elements of eddy current testing are discussed. An examination was made of the problems encountered in testing small-diameter tubing. Various systems used in eddy current testing are discussed. Techniques for high-speed inspection of small-diameter tubing by electromagnetically induced eddy currents have a much greater potential than is being utilized. Better advantage of this potential will be realized with the continued development of techniques and instrumentation. (B.O.G.)

20420

THE USE OF PENETRANTS FOR INSPECTION OF SMALL DIAMETER TUBING. R. B. Oliver, G. M. Tolson, and A. Taboada (Oak Ridge National Lab., Tenn.). p.127-41 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

Penetrant inspection is adaptable to small-diameter tubing surfaces on a production basis. The magnitude and type of defects this method will locate are primarily dependent on the emulsifying, cleaning, and developing operations. Precleaning procedures must be thorough and complete, insuring that all contaminants are removed from discontinuities, since contaminants in the discontinuities will exclude penetrant. Failure to detect discontinuities is generally the result of careless preparation, and false indications are the result of careless handling during processing. If all steps of the procedure are carefully performed, the penetrant inspection is a very valuable and reliable tool for the detection of small defects. (B.O.G.)

20421

AN APPROACH TO VERSATILITY IN EDDY CURRENT TESTING. P. D. Edwards (Los Alamos Scientific Lab., N. Mex.). p.142-9 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

An eddy current test bench composed of basic electronic circuits is described. By interconnection of these circuits and construction of suitable probes, such a bench can be used to perform a variety of electromagnetic tests, can cover a rather wide band of frequencies, and is especially useful for custom nondestructive testing as well as for the development of production line instrumentation. Specific applications of this bench to various plating problems, to graphite studies, and to instrument development programs are described. The probes developed for each application are depicted, and the resultant accuracy of the various measurements is given. (auth)

20422

RADIOGRAPHY OF MATERIALS USED IN THE NUCLEAR ENERGY FIELD. J. W. Dutli and D. E. Grimm (Los Alamos Scientific Lab., N. Mex.). p.150-64 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

Fundamental techniques employed for radiographing materials used in nuclear energy installations are described. The x- and gamma-ray energies required for radiographing a variety of materials from plastics to gold for thicknesses ranging from foils to several inches are discussed. The x-ray energies range from 10 kvp to 22 Mev; the gamma sources include cesium-137 and cobalt-60. Details of exposure for plastic, graphite, beryllium, zirconium, lead, thorium, tantalum, tungsten alloy, uranium, plutonium, and gold are given. Information on film-screen combinations and on filter protection against the autoradiographic effects is included. Some practical applications of radiography to reactor component inspections are shown. (auth)

20423

RADIOGRAPHY WITH THULIUM SOURCES. S. S. Sidhu, F. P. Campos, and D. D. Zauberis (Argonne National Lab., Ill.). p.165-8 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

Considering the radiation energies and half life characteristics of thulium-170, an evaluation was made for its application to the fields of radiography, therapy, and irradiation of materials. The relatively low-energy radiation emitted by the thulium source makes it suitable for radiography of low-density materials or thin sections of medium-density materials. Technique charts are included for aluminum, magnesium, and steel. The roentgen output from the present Tm sources is not high enough to give therapeutic treatments in a time comparable to that of x-ray machines. This output may be increased by increasing the amount of metal in the source. This will cause more active atoms to be present and may make the thulium source practical for therapeutic treatments. (B.O.G.)

20424

ULTRASONIC TESTING AS A METHOD OF DETERMINING VARIABLES IN PROCESSING ZIRCALOY AND HAFNIUM. Edwin W. Fink (Westinghouse Electric Corp., Pittsburgh). p.175-80 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

Tests are described which demonstrate the use of ultrasonics as a tool for the detection of defective material resulting from processing variables in the fabrication of Zircaloy and hafnium components. By following these procedures a large amount of critical material can be allocated for use, thereby eliminating scrap and costly time-consuming fabrication processes. (auth)

20425

MINIMIZING THE EFFECT OF PROBE-TO-METAL SPACING IN EDDY CURRENT TESTING. C. J. Renken, Jr. and D. L. Waidelich (Argonne National Lab., Ill.). p.181-90 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

A system is described which is adaptable to continuous processes since the probe is a significant distance from the sample and the effects of distance variations are largely canceled out. Its operation could be made almost completely automatic. It is relatively simple and very stable. The phase angle measuring instruments operate by measuring precisely very small time intervals and thus are expensive. An analysis of the bridge circuit in the apparatus is given. (B.O.G.)

20426

REDUCTION OF PROBE-SPACING EFFECT IN PULSED EDDY CURRENT TESTING. Donald L. Waidelich (Argonne National Lab., Ill.). p.191-200 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

In using pulsed eddy currents to determine the thickness of cladding, it was found that the output wave as observed on the screen of a cathode-ray oscilloscope had several unusual points. These points were stationary as the probe-to-metal spacing varied, but moved vertically as the cladding thickness changed. Tests on a clad plate seemed to indicate that the points could be used to determine cladding thickness with little interference from changes in the probe-to-metal spacing. One such method involves the use of small photocells placed in front of the oscilloscope screen with the output of the photocells connected to a recorder. The initial tests with such a system are presented. (auth)

20427

EDDY CURRENT MEASUREMENT OF CLAD THICKNESS. J. W. Allen, R. A. Nance, and R. B. Oliver (Oak Ridge National Lab., Tenn.). p.201-13 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The basic principles of eddy current testing as applied to metal thickness and cladding thickness measurements are discussed. Results of a series of studies are illustrated with the impedance changes of a probe coil plotted as functions of test frequency, thickness of the part inspected, or its electrical conductivity. Data are presented which indicate that the impedance curve determined as a function of life-off is complex in nature, having at least two inflection points. Special emphasis is given to an inspection method developed at the Oak Ridge National Laboratory for determining the thickness of cladding on the Mark X fuel plates used in the Materials Test Reactor. Results of this inspection method are presented illustrating its capability to measure small cladding thicknesses accurately and reliably. (auth)

20428

TESTING OF CYLINDRICAL FUEL ELEMENTS WITH THE CYCLOGRAPH. W. J. McGonnagle (Argonne National Lab., Ill.). p.214-24 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

An evaluation was made of the usefulness of the cyclograph for locating voids and cracks in the bonding layer, nonbonded areas, and thin spots in the clad of fuel elements. Both point and coil type probes can be used with

the cyclograph. The resolution when using concentric coils is determined by the length of the coil: the shorter the coil, the better the resolution. An advantage of the point probe is that a defect affects the eddy current of a probe much more than that of the concentric coil. (B.O.G.)

20429

APPLICATIONS OF LAMB WAVES IN ULTRASONIC TESTING. D. C. Worlton (General Electric Co., Pleasanton, Calif.). p.260-5 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

A discussion is given of some of the potential uses of Lamb waves, and methods are suggested for practical applications. The most salient feature of the technique from a testing standpoint is the ability to reveal shallow laminar defects in solid objects as well as plates. The requirement of short-time interrogating pulses is removed by eliminating the surface echo. The complexities and high frequencies of wide-band systems are thus avoided. Automatic gating is simplified so that the test is well suited for routine testing. (B.O.G.)

20430

RADIOGRAPHY OF FUEL ELEMENTS AND FUEL MATERIALS USING CESIUM-137. Merle L. Rhoten (Battelle Memorial Inst., Columbus, Ohio). p.266-72 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

It is evident that isotopes, as a source of radiation, do not compare to machine radiation for production line work or where a great number of exposures per day are required. Isotope exposures that may run from 20 to 60 min could be done in from 1 to 2 min with high-energy machine radiation. Although the isotopes require much longer exposure time, their cost is only a small percentage of that of a high-voltage x-ray machine. For radiography of the heavy metals encountered in the production of fuel elements, cesium-137 is a valuable source of radiation. Its wavelength is preferable for radiography of the thickness of these heavy metals. Cesium-137, emitting 0.661-Mev gamma rays, is a valuable source to fill the large void between the wavelengths of a 250-kvp x-ray machine and a cobalt-60 source. (auth)

20431

EDDY CURRENT TECHNIQUES FOR TESTING LIQUID METAL BONDING. C. J. Renken, Jr. and W. J. McGonnagle (Argonne National Lab., Ill.). p.273-7 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

Eddy current techniques are described which were used in testing EBR-II fuel elements. These elements are sodium-bonded, pin-type, U–Zr alloy in thin-walled (0.008 in.) stainless steel tubes. The tests were made by a Dumont cyclograph and an eddy current testing instrument developed at Argonne National Laboratory. The technique described and the results presented show that this method is applicable and adequate for testing sodium-bonded elements. (B.O.G.)

20432

ELECTRODE POTENTIAL METHOD OF BOND TESTING. W. G. Marburger, J. H. Monaweck, and W. J. McGonnagle (Argonne National Lab., Ill.). p.278-85 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The electrode potential method is capable of indicating and producing a permanent record of bond defects in fuel elements. The smallest detectable defect is one equivalent to a circular void of the order of 0.030 in. in diameter. The sensitivity of this method is greater for thinner than for thicker test specimens. (auth)

20433

NONDESTRUCTIVE BOND INSPECTION TEST BY ELECTRIC RESISTANCE MEASUREMENT FOR COMPLETE FLAT-PLATE FUEL ELEMENT SUBASSEMBLIES. C. V. Weaver, W. H. Goldthwaite, S. L. Fawcett, and R. W. Dayton (Battelle Memorial Inst., Columbus, Ohio). p.286-93 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

An instrument was developed for inspecting core-to-clad bonds in completed, flat-plate fuel assemblies. Normally, these inspections were made by frost testing or ultrasonic methods. The instrument is able to scan as much as 10 $in.^2$ per min, examining both sides of the plate at once. The equipment will produce immediately available permanent records of the location and magnitude of faults in each plate. A number of improvements in the prototype instrument are possible, and some are suggested. (B.O.G.)

20434

MEASUREMENT OF CLADDING THICKNESS ON URANIUM BY AUTORADIOGRAPHY. G. E. Bradley, W. J. McGonnagle, and P. R. Gonzales (Argonne National Lab., Ill.). p.294-303 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The use of the natural radioactivity of the core material was found to be a satisfactory way to measure the cladding thickness of zirconium clad fuel elements. The continuous scanning and recording system described can measure the cladding thickness of Experimental Boiling Water Reactor type fuel elements to an accuracy of ±0.5 mil at a scanning speed of 4 in. per min. (auth)

20435

RADIOGRAPHIC INSPECTION OF NUCLEAR CORE MATERIALS AND COMPONENTS. A. E. Oaks (Westinghouse Electric Corp., Pittsburgh). p.304-19 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The necessity of developing highly sensitive radiographic procedures for the routine inspection of zirconium, hafnium, and uranium alloy nuclear core components and fuel elements is reviewed. Problems encountered in the development of these procedures and some methods used to overcome them, such as shape correction forms and two-film techniques, are discussed. The utility of different types of radiographic equipment is discussed in terms of the requirements for the different attributes under inspection. Exposure data are given for zirconium, hafnium, and uranium alloys at 150 to 1000 kv. Conversion factors relating these alloys to equivalent thicknesses of steel are given. (auth)

20436

HELIUM LEAK DETECTION TECHNIQUES. W. H. Pappin (General Electric Co., Schenectady, N. Y.). p.328-38 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

An effective nondestructive test is described—the helium tuned mass spectrometer, otherwise known as the leak detector. It is a practical, relatively inexpensive, very accurate, and convenient nondestructive test. It is gaining popularity in many fields where leaktight joints are important. The field of leak detection is wide and varied. Several methods and techniques are used in the atomic reactor field to ensure leak tightness in large and small systems from fission gases or radioactive coolants. The leak detector is selective and can locate large and small leaks in the same system. It is fairly simple to operate; however, the application and evaluation of the test require skill. (auth)

20437

HELIUM LEAK DETECTOR TEST FOR NUCLEAR REACTOR WELDS. A. H. Barnes, F. A. Smith, and E. A. Wimunc (Argonne National Lab., Ill.). p.339-43 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The equipment and test procedure are described for leak detection tests of reactor fuel elements. Test results on 750 aluminum-clad fuel elements indicated that five were defective in that water could reach the uranium during reactor operation. Of the five defective fuel elements, two ruptured soon after exposure to water at 150°C and 75 psi, two gave indications of impending rupture, and one showed no change. The real effectiveness of this procedure can be evaluated only on the basis of a future large-scale program in which the tested fuel elements are loaded into a reactor. (B.O.G.)

20438

TWO METHODS FOR MEASURING TOTAL URANIUM CONTENT IN CO-EXTRUDED AlU_3O_8 REACTOR FUEL PLATES. G. E. Bradley, E. G. Leverenz, and W. J. McGonnagle (Argonne National Lab., Ill.). p.366-72 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

An investigation is described in which two different methods, radiographic and autoradiographic, were developed for determining the uranium content of Argonaut fuel elements. The element is prepared by the co-extrusion of an aluminum and uranium oxide core with an aluminum cladding. The radiographic transmission scanning method gives an accuracy of ±2% total uranium content, while the autoradiographic gamma emission method gives results to ±1% if the scanning time is less than 2 min. The latter method is more convenient and easier to use and is recommended as the better of the two methods. (B.O.G.)

20439

APPROXIMATE DETERMINATION OF ENRICHMENT OF REACTOR FUEL ELEMENT PLATES WITH IMPROVISED GAMMA RAY SPECTROMETER. G. E. Bradley (Argonne National Lab., Ill.). p.373-4 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The technique described is a simple one, requiring no other equipment than a scintillation detector equipped with a NaI(Tl) crystal, an oscilloscope, and a camera attachment. It is essentially one of γ-ray spectral analysis. It determines roughly the enrichment by the relative strength of the 0.180-Mev γ-ray range in which U^{235} has an energy level. Uranium-238 does not have a strong gamma ray at this level. Oscilloscope traces are shown for fuel elements of various enrichment. (B.O.G.)

20440

A NONDESTRUCTIVE METHOD FOR FUEL ASSAYING. S. G. Forbes (Phillips Petroleum Co., Idaho Falls, Idaho). p.375-81 of "Symposium on Nondestructive Tests in the Field on Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

A method is described for the nondestructive assay of MTR fuel assemblies for their U^{235} content before they are placed in the reactor. The accuracy attainable by this method is completely adequate from the reactor safety standpoint. For accountability purposes, accuracies of about 1% are feasible. Although the magnitudes of error resulting from various causes are difficult to assess with precision, in general they are <1%. (B.O.G.)

20441

A TECHNIQUE FOR GAMMA RADIOGRAPHIC INSPECTION OF PARALLEL-PLATE FUEL ASSEMBLIES. G. D. Calkins, M. Pobereskin, and R. B. Price (Battelle Memorial Inst., Columbus, Ohio) and N. M. Ewbank, Jr. (Atomics International, Canoga Park, Calif.). p.382-90 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

Using a 0.005-in. diameter tungsten wire, a line radiation source of tungsten-185 was prepared by neutron activation. Parallel wires mounted in a holder which fits into the coolant channel were used to locate the core alloy edge, necking, and defects in the core for two adjacent fuel plates in a multiplate assembly. From the radiation energy viewpoint, thulium-170 was a more suitable radiation source. Thulium is not available, however, as wire, and a development program for the production of uniform diameter thulium wire would be necessary. (auth)

20442

A PANORAMIC CAMERA FOR INSPECTING WALLS OF DEEP NARROW SLOTS. G. G. Cocks and C. M. Schwartz (Battelle Memorial Inst., Columbus, Ohio). p.391-5 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

The panoramic camera described can be adapted to the inspection of many types of narrow slots or channels. It can be used to inspect channel edges as well as sides. It has been demonstrated that the apparatus will work with slots as narrow as 0.050 in. The camera is capable of revealing tonal shades not seen under studio lighting conditions. The results obtained will depend on the straightness of the channel. (B.O.G.)

20443

IMPROVEMENTS RELATING TO THE TESTING OF VESSELS FOR ABILITY TO WITHSTAND INTERNAL PRES-

SURE. Ronald Frank Bishop and Alfred Puttick (to Whessoe Ltd.). British Patent 837,951. June 15, 1960.

A method is described for testing large vessels, particularly pressure vessels of reactors, for their ability to withstand high internal pressures. The vessel is placed inside a larger tank (the biological shield of a pressure vessel could be used for this purpose), and both vessel and tank are filled with water after a preliminary air testing of the vessel at low pressures for joint tightness. Pressure is applied to the water in the vessel and leakage detected by observing the fall in pressure on a sensitive gage. The advantages of this method are relief of vessel support stress and reduction of explosive fracture risks. (D.L.C.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

20444 AERE-M-666

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE TEMPERATURE GRADIENT IN THE ATMOSPHERE AT A.E.R.E. HARWELL, 1951–1952. H. J. Gale. Apr. 1960. 9p.

Histograms of the time distribution of the temperature gradient are given for each month from February 1951 to June 1952 for the Harwell Establishment. (C.J.G.)

20445 CEA-1423

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay.

C-14 DATING OF VOLCANIC ERUPTIONS. APPLICATION TO THE DATING OF A VOLCANO OF THE FRENCH MASSIF CENTRAL. G. Delibrias, J. Labeyrie, H. Pelletier, and M. Th. Perquis. [Sept. 1959]. 4p.

The volcanic eruption of Puy-de-la-Vache (Puy-de-Dôme) was dated by means of age measurements carried out on charcoal fragments found under a flow of lava; the result is 7650 ± 350 years. (auth)

20446 TID-6162

[Washington Univ., St. Louis.]

STUDIES RELATING TO THE DEVELOPMENT OF PROCEDURES FOR THE GEOLOGIC DATING OF CORALS AND OTHER CALCAREOUS MARINE AND TERRESTRIAL MATERIALS. Progress Report. June 8, 1960. 5p. Contract AT(11-1)-581. OTS.

Studies are in progress on geologically dating corals and other calcareous marine and terrestrial materials. Studies were also made on determining the U and Th content of marine carbonates. (W.L.H.)

20447 AEC-tr-4084

A STUDY OF THE RADIOACTIVITY OF HUNGARIAN SEDIMENTARY ROCKS. II. MANGANESE. Kalman Mehes. Translated from Foldtani Kozlony 85, 386-9(1955). 5p. JCL.

Using a Geiger-Mueller counter, the radioactivity of several sedimentary manganese ore samples from Hungary was measured. (C.J.G.)

20448

HIGH HAFNIUM ZIRCON FROM NORWAY. A. A. Levinson and R. A. Borup (Dow Chemical Co., Freeport, Tex.). Am. Mineralogist 45, 562-5(1960) May-June.

High hafnium zircons from Iveland, Norway, are described which were found to contain 22 to 24% HfO_2. The ratio Hf/Zr is about 0.6. The zircons occurred protruding from a crystal of thortveitite (scandium silicate). The presence of hafnium and zirconium within the structure of thortveitite is confirmed. (auth)

20449

NEW DATA ON THE HAFNIUM, ZIRCONIUM AND YTTRIUM CONTENT OF THORTVEITITE. A. A. Levinson and R. A. Borup (Dow Chemical Co., Freeport, Tex.). Am. Mineralogist 45, 712-15(1960) May-June.

Three thortveitite specimens, two from Norway and one from Madagascar, were analyzed by x-ray fluorescence for their Hf, Y, and Zr contents. Emission spectrographic analysis was performed as a check, and the data agree, giving Hf/Zr ratios of 0.6 and 1.0 for the Norwegian specimens and 1.2 for the madagascar specimen. A discussion is presented on the relationship of thortveitite as a host to high-hafnium zircon and on the Y contents. (D.L.C.)

20450

AUTOMATIC MEASUREMENTS AND COMPUTATIONS FOR RADIOCHEMICAL ANALYSES. John N. Rosholt, Jr. and J. R. Dooley, Jr. (U. S. Geological Survey, Denver). Anal. Chem. 32, 1093-8(1960) Aug.

In natural radioactive sources the most important radioactive daughter products useful for geochemical studies are protactinium-231, the alpha-emitting thorium isotopes, and the radium isotopes. To resolve the abundances of these thorium and radium isotopes by their characteristic decay and growth patterns, a large number of repeated alpha activity measurements on the two chemically separated elements were made over extended periods of time. Generation of the required theoretical decay and growth functions, varying with time, and the least squares solution of the overdetermined simultaneous count rate equations are done with a digital computer. Examples of the complex count rate equations which may be solved and results of a natural sample containing four α-emitting isotopes of thorium are illustrated. These methods facilitate the determination of the radioactive sources on the large scale required for many geochemical investigations. (auth)

20451

FLAME SPECTROPHOTOMETRIC DETERMINATION OF LITHIUM IN LITHIUM MINERALS. James L. Kassner (University of Alabama, University) and Virgil M. Benson and Ellis E. Creitz (Bureau of Mines, University, Ala.). Anal. Chem. 32, 1151-3(1960) Aug.

A relatively rapid and reliable method is needed to determine lithium in lithium-bearing minerals ranging from 0.10 to over 8.0% lithia. A procedure is proposed in which the sample is decomposed with a mixture of nitric, hydrofluoric, and perchloric acids. Removal of interfering ions (principally ferric, chromic, and aluminum) before analysis is not necessary. The effects of these ions on the intensity of the lithium spectrum are largely eliminated by buffering the solution within the pH range of 1 to 4 with a citric acid–ammonium citrate buffer. Under these conditions, beryllium is the only element commonly found in pegmatitic materials that produces an error. One analyst can start 12 samples and complete the analysis of another set of 12 samples each 8-hour working day. Precision and accuracy are good. (auth)

20452

GEOLOGICAL-RADIOMETRIC EXPLORATIONS IN THE PROVINCE OF ICA. Víctor Jordán Ormeño. Bol. inform. junta control energía atómica (Peru) 5, 21-37(1960) Jan.–Feb. (In Spanish)

The area between the cities of Ica and Palpa were examined geologically and radiometrically. The aim was to prospect the contact zone between the Batolito Andino in-

trusions with the preexisting rocks, to verify the radiometric control of the known mines, and to localize species of uranium minerals. The only radiometric anomalies found have very small economic importance at present, but prove the presence of uranium, generally associated with copper minerals. (J.S.R.)

20453

GEOLOGY AND RADIOMETRY OF THE AREA OF THE SAYAPULLO MINE (CAJAMARCA). Bol. inform. junta control energía atómica (Peru) 5, 37-48(1960) Mar.-Apr. (In Spanish)

The Sayapullo Mine, which was worked by the Incas, is located in the Cajamarca Department approximately 155 km northeast of Trujillo. The general geology of the area is briefly considered. Minerals of copper, zinc, silver, and lead predominate. Uranium mineralization is found in connection with pyrite. The uranium present is of secondary economic importance. (J.S.R.)

20454

RADIOACTIVITY OCCURRENCE IN THE YASO ZONE. Guillermo Morales Serrano. Bol. inform. junta control energía atómica (Peru) 5, 39-40(1960) Jan.-Feb. (In Spanish)

The radioactivity occurrence known as the "Pichu Prospect" is located in the Canta Province and is localized in one of the mines developed by the Spaniards. The predominant rocks are intrusive with composition varying between granodiorite and diorite. The mineralization structure is hydrothermal. The radioactivity reaches 0.15 mr/hr. No primary uranium minerals were found. However, detailed exploration is recommended. (J.S.R.)

20455

DETERMINATION OF THE ABSOLUTE AGE OF FRENCH GALENAS BY MASS SPECTROMETRY. Georges L. Durand (École Nationale Supérieure de Géologie Appliquée, Nancy, France). Compt. rend. 250, 4018-19(1960) June 13. (In French)

The absolute ages of 13 French galenas were determined by measuring the ratios $\alpha = Pb^{206}/Pb^{204}$ and $\beta = Pb^{207}/Pb^{204}$. The results are tabulated. (tr-auth)

20456

THE SIMULTANEOUS MEASUREMENT OF THE ACTIVITY OF RADON AND OF ITS DESCENDANTS IN ATMOSPHERIC AIR. POSSIBLE APPLICATION TO THE PROSPECTION FOR URANIUM AT A DISTANCE. Daniel Blanc, Jacques Fontan, and Gilbert Vedrenne (Centre de Physique nucléaire, Faculté des Sciences, Toulouse, France). Compt. rend. 250, 4349-51(1960) June 27. (In French)

The association of an installation previously described (Compt. rend. 250, 3629(1960)) with a filter paper unrolling before a photomultiplier permits the simultaneous measurement of the activity of radon and of its descendants. The ratio of these activities depends on the time since the radon was released from the soil. From a knowledge of the wind and its velocity, one can thus localize at a distance uranium deposits. (tr-auth)

20457

ON THE RELIABILITY OF DEFINING THE AGE OF MONAZITES BY THE URANIUM METHOD. S. I. Danilevich. Doklady Akad. Nauk S.S.S.R. 132, 443-6(1960) May 11. (In Russian)

The ratios of Th/U, Pb^{207}, and ordinary lead were introduced as three combined factors for evaluation of monazite age. The coefficient $A = (Pb^{207}/Pb^{H})(x\ 100/x\ Th/U)$ (where Pb^{207} is the content of Pb^{207} in at.% in monazite lead, Pb^{H} is the content of non-radiogenic lead in %, and Th/U is the ratio in monazites) was introduced in order to determine the influence of these factors on age determination by the uranium method. Data on monazites with $1.0 < A < 45.7$ and $A < 1$ are shown as illustrations of the A coefficient applications. The investigation indicates that a more accurate monazite age evaluation can be achieved considering the ratios Pb^{206}/U^{238}, Pb^{207}/U^{235}, and Pb^{207}/Pb^{207}, which are in some cases more accurate than the Pb^{208}/Th ratio. (R.V.J.)

20458

THE CRYSTAL STRUCTURE OF META-AUTUNITE $Ca(UO_2)_2(PO_4)_2 \cdot 6H_2O$. E. S. Makarov and V. I. Ivanov (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 132, 673-6(1960) May 21. (In Russian)

Quantitative and qualitative chemical analyses of metaautunites $[Ca(UO_2)_2(PO_4)_2 \cdot 6H_2O]$ showed good agreement with the accepted formula and indicated 6 molecules of water per formula unit. The cross section of the metaautunite structure in (110) plane is shown. Observations of atomic positions indicate the following distances: $U-O_I' = 1.99$ A, $U-O_I'' = 1.79$A, $U-4O_{II} = 2.32$ A, $P-4O_{II} = 1.47$ A, $O_{II}-O_{II} = 2.31$ A, $H_2O-H_2O = 1.83$ A, $O_I'-4H_2O = 2.36$ A, $O_I'-O_{II} = 3.06$ A, $O_I''-4H_2O = 3.53$ A, $O_I''-O_{II} = 4.35$ A, $Ca-O_I' = 2.27$ A, $Ca-O_I'' = 2.35$ A. The nonequilibrium of the uranyl group $U-O_I = 1.99$ A and $U-O_I'' = 1.79$ A is the result of a stronger O_I' bond with surrounding water molecules and phosphate oxygen than the O_I''. The obtained values for interatomic distances in metaautunite structure are applied for determining the bond length and the bond strength of the uranyl-containing structures. The valence of uranium in metaautunites was determined using P^{5+} and oxygen O_{II}^{2-} resulting in the bond $U-O_{II} = 0.75$, which produces a crystal chemical formula $Ca^{2+}(UO_2^{3+})_2(PO_4^{3-})_2 \cdot 6H_2O$. Using the experimental magnitude of the bond length $U-O_{II} = 2.32$ A, where the bond strength is 0.60, the chemical crystal formula is $Ca^{2+}(H_3O^{+})_2(UO_2^{+})_2 \cdot (PO_4^{3-})_2 \cdot 4H_2O$. (R.V.J.)

20459

THE CARBON-14 CONTENT OF URBAN AIRBORNE PARTICULATE MATTER. James P. Lodge, Jr. (Robert A. Taft Sanitary Engineering Center, Cincinnati) and George S. Bien and Hans E. Suess (Scripps Inst. of Oceanography, La Jolla, Calif.). Intern. J. Air Pollution 2, 309-12(1960) June.

Very large samples of atmospheric particulate matter were collected in the central part of St. Louis, Missouri and Los Angeles, California. The carbon-14 content of various fractions of the samples was determined and interpreted in terms of the relative contribution of fossil fuels and contemporaneous sources of carbon to the particulate pollution of the area. It can be shown by this method, for example, that substantially all of the aliphatic hydrocarbons in the samples are of fossil origin, while about one-fourth of the oxygenated materials are derived from living matter. The general applicability of the method is discussed. (auth)

20460

RADIOACTIVE FALL-OUT IN GHANA. A. H. Ward and J. D. Marr (University Coll., Legon, Ghana). Nature 187, 299-300(1960) July 23.

Survey measurements were begun in October 1959, prior to the first atomic explosion by the French at Reggan in the northern Sahara. The results are shown graphically for air-borne and deposited dust for the January 1960 average and through March 20, 1960. The sharp increase following the February 13 detonation was described as much higher than that predicted for Ghana. Calculations indicate a total gonad dose for the maximum "north" fallout of less than 1 millirad. (B.O.G.)

20461

THE MODERN VIEW ON RADIOACTIVITY CONTROL IN WATER. H. Kiefer and R. Maushart (Kernforschungszentrum, Karlsruhe, Ger.). Neue Technik 2, No. 3, 42-5(1960) Mar. (In German)

A view is given on the tasks of the control of radioactivity in water. The different control methods are discussed. This chapter deals with the methods of direct control: β-control; α-control; γ-control. (auth)

20462

THE MODERN VIEW ON CONTROL OF RADIOACTIVITY IN WATER. H. Kiefer and R. Maushart (Kernforschungszentrum, Karlsruhe, Ger.). Neue Technik 2, No. 4, 12-16 (1960) Apr. (In German)

The second part of this paper deals with methods of activity measurement in water after previous enrichment. Different methods are cited: Enrichment by vaporization, precipitation, ion exchange. Then a method of continuous enrichment is treated; finally, the problem of identification of radionuclides is discussed. (auth)

20463

AGE DETERMINATION BY X-RAY FLUORESCENCE RUBIDIUM–STRONTIUM RATIO MEASUREMENT IN LEPIDOLITE. Leonard F. Herzog, II (Pennsylvania State Univ., University Park). Science 132, 293-4(1960) July 29.

X-ray fluorescence analysis of several lepidolites whose rubidium and strontium concentrations had already been determined by neutron activation and stable isotope dilution, or both, indicates that this technique can be used for rapid nondestructive reconnaissance rubidium-strontium studies, and that an x-ray analysis method comparable in accuracy to isotope dilution can probably be developed for dating Precambrian lepidolites. (auth)

20464

RADIOACTIVATION METHOD FOR DETERMINING BERYLLIUM IN MINERAL RAW MATERIALS AND HYDROMETALLURGY PRODUCTS. Kh. B. Mezhiborskaya. Zhur. Anal. Khim. 15, 281-6(1960) May-June.

The design of an installation and γ source for determining beryllium by the radioactivation method is described. The influence of some effects distorting the results of the analysis (such as self-absorption of photoneutrons, absorption of γ rays) is considered and recommendations are given as to the elimination of errors caused by these effects. (auth)

20465

Geological Survey, Washington, D. C.
URANIUM IN COAL IN THE WESTERN UNITED STATES. Geological Survey Bulletin 1055. 1959. 320p. 39 illus. (GPO).

Extensive investigations were made of the occurrence and distribution of U in coal and related carbonaceous materials throughout large areas in the western United States. Ten papers are presented. Separate abstracts are prepared for each paper. (W.L.H.)

20465

URANIUM BEARING LIGNITE IN NORTHWESTERN SOUTH DAKOTA AND ADJACENT STATES. Norman M. Denson, George O. Bachman, and Howard D. Zeller. U. S. Geol. Survey Bull. No. 1055, 11-57(1959).

In northwestern South Dakota and adjacent areas, uranium-bearing lignite beds occur at many horizons in the Hell Creek formation of Late Cretaceous age and in the overlying Ludlow, Tongue River, and Sentinel Butte members of the Fort Union formation of Paleocene age. Analyses for uranium of 275 samples of lignite taken from outcrops or obtained by auger-drilling and of about 1000 core samples of lignite show that many of the lignite beds contain 0.005 to 0.02 percent uranium, and their ash contains 0.05 to 0.10 percent. Analytical data also indicate that the region contains an aggregate of at least 47,500,000 tons of lignite having an average uranium content of slightly more than 0.008 percent. Almost a fifth of the lignite occurs in beds suitable for strip mining and averaging about 4 feet in thickness. Recent discoveries of ore-grade deposits of autunite-bearing lignite and of secondary minerals of uranium in carbonaceous sandstone at Cave Hills and Slim Buttes indicate that northwestern South Dakota and adjacent areas may contain important deposits of uranium minerals. The stratigraphic units containing the uraniferous lignite beds have a combined thickness of about 1500 feet and are unconformably overlain by a sequence of 300 feet or more of tuffaceous sandstone and bentonitic claystone of the White River group of Oligocene age and the Arikaree formation of Miocene age. The stratigraphically highest lignite beds in the area have the greatest content of uranium, and the concentration of uranium is greatest at the top of thick lignite beds, diminishing progressively downward to a vanishing point in their lower parts. Variations in permeability of the rocks overlying the mineralized lignite beds seem to be related to the concentration of uranium. Most of the known beds of uranium-bearing lignite in the region are closely overlain by rocks of the White River group and the Arikaree formation, which have about 12 times more uranium than the average sedimentary rock. Furthermore, the uranium content of spring water from these formations is 30 or more times that of normal ground water. The presence of uranium in the lignite is independent of the age of the formation in which the lignite occurs. Field relations thus suggest that the uranium is of secondary origin and has been introduced after the accumulation and marked regional uplift and warping of the lignite beds and associated rocks. (auth)

20467

CORE DRILLING FOR URANIUM-BEARING LIGNITE IN HARDING AND PERKINS COUNTIES, SOUTH DAKOTA, AND BOWMAN COUNTY, NORTH DAKOTA. Howard D. Zeller and James M. Schopf. U. S. Geol. Survey Bull. No. 1055, 59-95(1959).

Twenty core holes having a total footage of 1907 feet were drilled and from them 94 feet of lignite were taken for analyses for uranium during part of the summers of 1951 and 1952 in northwestern South Dakota and southwestern North Dakota. About 9 million tons of lignite averaging 0.01 percent uranium are estimated to be present in the areas covered by this report. The results of 191 chemical determinations for uranium show that generally the greatest concentrations of uranium are in the upper parts of uranium-bearing lignite beds 3 feet or more in thickness and that the uranium content decreases downward to near the vanishing point in succeeding lower beds. The results of 191 semiquantitative spectrographic analyses of the ash from the lignite cores reveal that molybdenum closely parallels uranium in distribution and concentration and may possibly be significant as an indicator element in prospecting for uranium. (auth)

20468

CORE DRILLING FOR URANIUM-BEARING LIGNITE, MENDENHALL AREA, HARDING COUNTY, SOUTH DAKOTA. James R. Gill, Howard D. Zeller, and James M. Schopf. U. S. Geol. Survey Bull. No. 1055, 97-146(1959).

Core drilling for data on uranium-bearing lignite in the Mendenhall area, near the center of the Slim Buttes, Harding County, S. Dak., was conducted by the Geological Sur-

vey in the summer of 1951 and by the Bureau of Mines during the period October 1952–July 1953. Samples from 49 core holes having a total footage of 11,146 feet, drilled in an area of about 9 square miles, indicate a reserve of about 127 million tons of lignite, of which about 49 million tons contain an average of 0.005 percent uranium or more. The uranium-bearing lignite averages 5.4 feet in thickness and occurs in the Ludlow member of the Fort Union formation of Paleocene age. Fuel analyses of about 130 samples indicate that the lignite contains about 15 percent ash, 37 percent moisture, 24 percent fixed carbon, 24 percent volatile matter, and 1.5 percent sulfur and has a heating value of about 5800 Btu (as received condition). In the Slim Buttes, exclusive of the Mendenhall area, approximately 60 square miles are underlain by uranium-bearing lignite having an average thickness of five feet and an average uranium content of 0.007 percent or more, and having a potential reserve of 340 million tons of uranium-bearing lignite. The core samples indicate only the stratigraphically highest lignite bed beneath the unconformity at the base of the Chadron formation of Oligocene age contains appreciable quantities of uranium. Data indicate that the uranium in the lignite is of secondary origin, having been leached and transported by ground water from the mildly radioactive tuffaceous rocks that unconformably overlie the lignite-bearing strata. (auth)

20469

URANIUM-BEARING LIGNITE IN SOUTHWESTERN NORTH DAKOTA. George W. Moore, Robert E. Melin, and Roy C. Kepferle. U. S. Geol. Survey Bull. No. 1055, 147-66(1959).

Beds of uranium-bearing lignite were mapped and sampled in the Bullion Butte, Sentinel Butte, HT Butte, and Chalky Buttes areas in southwestern North Dakota; they occur at several stratigraphic positions in the Sentinel Butte member of the Fort Union formation of Paleocene age. A total of 261 samples from 85 localities were collected for uranium analysis. Lignite containing as much as 0.045 percent uranium, 10.0 percent ash, and 0.45 percent uranium in the ash was found; the average uranium content of the lignite is about 0.013 percent. About 27 million tons of lignite in beds about 2 feet thick underlie the four areas. Surface samples of the lignite average more than 30 percent ash. The principal factor that seems to influence the concentration of uranium in the lignite beds is the stratigraphic position of the beds in relation to the base of the overlying White River group of Oligocene age. All uranium-bearing beds closely underlie the base of the White River group. The relative concentration of uranium is modified by other factors, however, as beds enclosed in permeable rocks are more uraniferous than beds in impermeable rocks, and thin beds have a greater uranium content than thick beds. In addition, a thick lignite bed commonly has a greater concentration in the top part of the bed. These and other factors suggest that the uranium is of secondary origin and that it was leached from volcanic ash in overlying rocks of Oligocene and Miocene age. Probably the uranium is held in the lignite as part of a metallo-organic compound. (auth)

20470

RECONNAISSANCE FOR URANIUM IN THE EKALAKA LIGNITE FIELD, CARTER COUNTY, MONTANA. James R. Gill. U. S. Geol. Survey Bull. No. 1055, 167-79(1959).

Beds of uranium-bearing lignite 1.5 to 8 feet thick occur in the Fort Union formation of the southern part of the Ekalaka Hills, Carter County, Mont. Data from surface outcrops indicate that an area of about 1400 acres is underlain by 16.5 million tons of uranium-bearing lignite. The uranium content of the lignite beds ranges from 0.001 to 0.034 percent, the average being about 0.005 percent. Ironstone concretions in the beds of massive coarse-grained sandstone in the upper part of the Fort Union formation contain 0.005 percent uranium in the northern and eastern parts of the area. These beds of sandstone are favorable host rocks for uranium occurrences and are lithologically similar to beds of massive coarse-grained sandstone of the Wasatch formation in the Pumpkin Buttes area of the Powder River Basin. (auth)

20471

URANIUM-BEARING COAL IN THE RED DESERT AREA, SWEETWATER COUNTY, WYOMING. Harold Masursky and George N. Pipiringos. U. S. Geol. Survey Bull. No. 1055, 181-215(1959).

Uranium-bearing coal occurs in the Red Desert area of Sweetwater County, Wyo., in a zone 15 miles wide which extends in a northwesterly direction for 30 miles north of Wamsutter, Wyo. The thickest coal is found along the transition zone between the fluviatile sandstone of the Wasatch formation and the lacustrine shale of the Green River formation, both of Eocene age. Each coal bed is lenticular and grades into shale to the northeast and southwest. The greatest concentrations of uranium in the coal occur locally where the beds are overlain by conglomerate of possible Miocene age. Widespread but lesser concentrations of uranium occur in coal where a bed is in proximity to intercalations of coarse-grained, permeable, fluviatile sandstone which were derived from a source area to the northeast. The close relationship between uranium in the coal and the permeability of the adjacent beds indicates that the uranium is of epigenetic origin. Preliminary estimates indicate that the rocks in the mapped area contain about 700 million short tons of subbituminous B coal in beds not less than 2.5 feet thick and overlain by not more than 75 feet of overburden. The Luman No. 1 coal bed, the principal objective of a drilling program in 1952, contains about 12 million short tons of subbituminous coal that averages 3.9 feet in thickness, under not more than 75 feet of overburden. The uranium content of the Luman No. 1 bed averages about 0.006 percent, the ash content averages about 20 percent, and the uranium content of the ash averages about 0.030 percent. The average heating value of the coal in the "as received" condition is 7600 Btu. The average uranium content of other coal in the rest of the area is about 0.003 percent, although locally, as at Creston Ridge in the southeastern part of the area, impure coal contains as much as 0.051 percent uranium. The study indicates that the coal in the Red Desert area is of interest primarily as a fuel resource and contains only small concentrations of uranium. Thin carbonaceous shale interbedded with coarse-grained sandstone to the north and east of the principal area underlain by coal, however, may contain high-grade deposits of uranium. (auth)

20472

TERTIARY GEOLOGY OF THE GOOSE CREEK DISTRICT, CASSIA COUNTY, IDAHO, BOX ELDER COUNTY, UTAH, AND ELKO COUNTY, NEVADA. William J. Mapel and William J. Hail, Jr. U. S. Geol. Survey Bull. No. 1055, 217-54(1959).

The Goose Creek district is an area of about 260 square miles in the northern and central parts of an intermontane basin in southern Idaho and adjacent parts of Utah and Nevada and is drained by Goose Creek, a large perennial tributary of the Snake River. Tertiary rocks exposed in the

district include the Payette(?) formation, of Miocene or Pliocene age, and the overlying Salt Lake formation, of Pliocene age. The Payette(?) formation is at least 900 feet thick and consists mainly of greenish-gray shale and white volcanic ash. The Salt Lake formation is at least 2300 feet thick and consists largely of volcanic ash and welded rhyolitic tuff. Both formations contain thin beds of car-, bonaceous shale and lignite, and at various stratigraphic levels there are numerous beds of sandstone and conglomerate derived from the disintegration and erosion of older rocks exposed on adjacent highlands. The Tertiary sedimentary rocks rest unconformably on a large body of Tertiary(?) rhyolite exposed in the mountains bordering the district on the southeast, and on a thick undifferentiated sequence of Carboniferous and older rocks, limestone, quartzite, and shale, exposed in the mountains to the west and northeast. Quaternary deposits of gravel, slope wash, alluvium, and landslide material overlie the older rocks locally. The Payette(?) and Salt Lake formations are tilted in a general easterly direction, with an average dip of about 3 degrees. Shallow folds and structural terraces modify the eastward tilting, particularly along the eastern margin of the district, where dips in the Tertiary rocks locally are reversed. Normal faults with displacements ranging from a few feet to as much as 900 feet cut the Tertiary sequence at various places. Most of the faults trend northward or northeastward, and some may be traced for several miles. Lignite has been mined for local use from both the Payette and Salt Lake formations, but most of the lignite has a large content of ash and is of little commercial value. Concentrations of as much as 0.1 percent uranium occur locally in lignite and carbonaceous shale in the lower part of the Salt Lake formation. Most of the uranium-rich beds are on the flanks and in the trough of a shallow syncline in T. 16 S., R. 21 E., Idaho. Other mineral resources include building stone and bentonite. (auth)

20473

GEOLOGY AND URANIUM DEPOSITS IN CARBONACEOUS ROCKS OF THE FALL CREEK AREA, BONNEVILLE COUNTY, IDAHO. James D. Vine. U. S. Geol. Survey Bull. No. 1055, 255-94(1959).

Uranium occurs in carbonaceous rocks of the Bear River formation, of Early Cretaceous age, in the Fall Creek area, Bonneville County, Idaho. The principal deposit is at the Fall Creek coal prospect in sec. 4, T. 1 S., R. 42 E., where impure coal contains an average of about 0.02 percent uranium. Geologic mapping and sampling have demonstrated that the zone of uranium-bearing rocks is widespread in the area and is repeated in outcrop several times, owing to folding and faulting of the enclosing strata, although exposures suitable for sampling and analysis are few. Analytic data suggest a possible geochemical relation between uranium, germanium, and molybdenum. Four general hypotheses are advanced for the origin of uranium in carbonaceous rocks, but comparison of the deposits with other occurrences of uranium-bearing carbonaceous rocks suggests that an epigenetic hypothesis of deposition by downward percolating meteoric water seems best able to explain the occurrence of uranium in the Fall Creek area. Core drilling was inconclusive in demonstrating the areal extent of the radioactive units. Most of the holes did not reach the uranium-bearing strata, because the area is one of structural complexity, with faulting, thinning of incompetent strata, and increasingly steep dips at depth. About 6½ million tons of coaly shale, carbonaceous shale, and carbonaceous limestone with an average grade of about 0.02 percent uranium is believed to be in the area. This estimate is based on the average thickness and grade of uranium-bearing strata exposed in the Fall Creek coal prospect, by drill-hole data, and by the inferred extent of these strata over an area of slightly more than 400 acres. (auth)

20474

URANIUM-BEARING COAL AND CARBONACEOUS SHALE IN THE LA VENTANA MESA AREA, SANDOVAL COUNTY, NEW MEXICO. George O. Bachman, James D. Vine, Charles B. Read, and George W. Moore. U. S. Geol. Survey Bull. No. 1055, 295-307(1959).

Uranium-bearing coal, carbonaceous shale, and carbonaceous sandstone of Late Cretaceous age occur on and adjacent to La Ventana Mesa, Sandoval County, N. Mex. The uranium is present in three lenticular beds forming a mineralized zone several feet thick at the base of the La Ventana tongue of the Cliff House sandstone. An epigenetic origin for the uranium from ground-water solutions that ultimately derived the uranium from the Pleistocene Bandelier rhyolite tuff of Smith (1938) is suggested. The content of uranium in the coal is as much as 0.62 percent and in the coal ash is as much as 1.34 percent. It is estimated that 132,000 tons of coal and carbonaceous shale containing an average of 0.10 percent uranium are present on La Ventana Mesa. (auth)

20475

METHODS IN GEOCHEMISTRY. A. A. Smales and L. R. Wager, eds. New York, Interscience Publishers Inc., 1960. 467p. $13.50.

This volume contains five chapters which cover the following subjects: collection and preparation of material for analysis; analysis by gravimetric and volumetric methods, flame photometry, calorimetry, and related techniques; spectrochemical analysis; polarography; and some modern chemical separation methods. Also included, and covered by separate abstracts, are five chapters on fluorescent x-ray spectrography, stable isotope geochemistry and mass spectrometric analysis, mass spectrometric isotope dilution analysis, radiochemical methods, and radioactivation analysis. (M.C.G.)

20476

FLUORESCENT X-RAY SPECTROGRAPHY. H. I. Shalgosky (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). p.111-47 of "Methods in Geochemistry." A. A. Smales and L. R. Wager, eds. New York, Interscience Publishers Inc., 1960.

The most serious disadvantage for the geochemist in analysis by fluorescent x-ray spectrography is that elements with atomic numbers less than 16 cannot readily be determined. Secondary or characteristic x rays are emitted by elements excited by primary x rays. X-ray tubes and plane and curved crystal spectrographs were developed for irradiating targets with primary x rays and then dispersing the characteristic spectra. Geiger, proportional, and scintillation counters designed for rapid and accurate determination of the intensity of the radiation greatly increased the applications of this method. The simplicity of x-ray spectra made qualitative analysis extremely rapid. Apart from identification of individual elements, it may be used for comparing the composition of specimens. Quantitative results may also be obtained, but they apply only to the surface layers of the specimen and care should be taken to make the surface representative. Applications of fluorescent x-ray spectrography may be made to many analyses. (M.C.G.)

20477

STABLE ISOTOPE GEOCHEMISTRY AND MASS SPECTROMETRIC ANALYSIS. K. I. Mayne (Clarendon Lab.,

Oxford). p.148-201 of "Methods in Geochemistry." A. A. Smales and L. R. Wager, eds. New York, Interscience Publishers Inc., 1960.

The existence of widespread variations in the isotopic composition of materials found in nature permits the assessment of physico-chemical processes in geology, meteorology, and hydrology, as well as provide a means of determining the history of geological events. The principles of those processes which can lead to isotopic fractionation and the ways these effects can be observed and interpreted in nature were investigated. These studies were restricted to stable isotopes analyzed by mass spectrometry of gaseous and solid sample material. The principles and limitations of this method for measuring isotopic abundances were discussed. (M.C.G.)

20478

MASS SPECTROMETRIC ISOTOPE DILUTION ANALYSIS. R. K. Webster (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.202-46 of "Methods in Geochemistry." A. A. Smales and L. R. Wager, eds. New York, Interscience Publishers Inc., 1960.

In the method of stable isotope dilution, the quantity of an element is estimated from the change produced in its isotopic composition by the addition of a known quantity of a stable isotopic tracer of that element. Isotopic dilution analysis may be applied to at least four-fifths of the elements. For many of these very high sensitivities can be obtained for only trace amounts. Its freedom from interference effects and systematic errors makes it probably the most accurate of the general methods of trace analysis. Its main geochemical application was in the field of age determination. (M.C.G.)

20479

RADIOCHEMICAL METHODS. S. Moorbath (Oxford Univ.). p.247-96 of "Methods in Geochemistry." A. A. Smales and L. R. Wager, eds. New York, Interscience Publishers Inc., 1960.

Radiations emitted by a radioactive isotope are characteristic of the nuclide producing them and can be used both for qualitative and quantitative analyses of extreme sensitivity. More than 50 natural and artificial radionuclides which have sufficiently long lifetimes to be of general radiochemical application are commercially available. The nature of radioactivity, the types of decay, and the radioactive decay series are reviewed. Geiger-Mueller, proportional, and scintillation counters, auxiliary electronic apparatus, and other instrumentation are described briefly. In the application of radiochemistry to geochemical problems, the techniques may be divided into two groups: those used in the assay of naturally occurring radio-nuclides and those involving the use of natural and artificial radioactive tracers. (M.C.G.)

20480

RADIOACTIVATION ANALYSIS. D. Mapper (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.297-357 of "Methods in Geochemistry." A. A. Smales and L. R. Wager, eds. New York, Interscience Publishers Inc., 1960.

In radioactivation analysis, the amount of an element present in a sample is determined by irradiating the sample with suitable nuclear particles and then measuring the intensity of the characteristic radioactivity induced in the element. The intensity is directly proportional to the amount of the element irrespective of its state of chemical combination. The great advantage of radioactivation analysis is its sensitivity. For example, 10^{-9} to 10^{-10} g of arsenic can readily be determined. The irradiation facilities and experimental methods required for this method of analysis, the interactions of neutrons with matter, limitations caused by conflicting nuclear processes, the sensitivity, precision, and accuracy of the method, modifications of the basic activation method, and its practical applications in geochemistry are discussed. Various publications on these applications to geochemical studies are reviewed. (M.C.G.)

HEALTH AND SAFETY

20481 AECL-1027

Atomic Energy of Canada Ltd., Chalk River, Ont.
HEALTH AND SAFETY ORGANIZATION. June 1, 1960. 22p.

Policies and procedures for health and safety, particularly radiation safety, at Atomic Energy of Canada Limited are outlined. (C.H.)

20482 AERE-ES/R-2674

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
DECONTAMINATION SUIT (THE "NEWT" SUIT). W. K. Curtis and D. W. Kingston. Sept. 1958. Decl. May 20, 1960. 20p. BIS.

The performance of a decontamination suit ("Newt" suit) containing an access tunnel sealed to a cell is described. Features of the suit include communications, ventilation to all parts of the body, and a safety harness. (C.J.G.)

20483 CEA-1538

France. Electricité de France, Paris and France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay.
ETUDE DES CONSEQUENCES DE L'ACCIDENT DE WINDSCALE (OCTOBRE 1957) ET DE LA VALIDITE DU MODELE MATHEMATIQUE DE DIFFUSION ATMOSPHERIQUE DE SUTTON. (Consequences of Windscale's Accident (October 1957) and Study of the Validity of the Sutton's Mathematical Model of Atmospheric Diffusion (1960)). J. J. Martin and A. Doury. 1960. 32p.

The reactor accident that happened at the number 1 pile of Windscale in 1957 was followed by a discharge of radioactive products into the atmosphere from Oct. 1, 1957 at 4:30 PM to Oct. 12, 1957 at 3:10 PM. On October the 11th it was possible to say that there was no more risk either of external irradiation or inhalation. But in adopting a M.A.C. of 0.1 μcurie of I^{131} per liter of milk, the Authority had to control the milk delivery till November 23rd on a 500 km^2 area. This accident permitted a verification of Sutton's atmospheric diffusion model. (auth)

20484 FFIF-IR-F-395

Norway. Forsvarets Forskningsinstitutt, Lillestrøm.
DETERMINATION OF FALLOUT RADIOACTIVITY IN THE ATMOSPHERE BY MEANS OF AN AIRBORNE FILTER. D. Hveding. May 18, 1960. 58p.

An airborne filter apparatus and measuring procedure are described for use in determinations of fall-out radioactivity in the atmosphere. Data collected at various altitudes over Norway during 1957, 1958, 1959, and part of 1960 are tabulated. (C.H.)

20485 HMI-B-11

Hahn-Meitner-Institut für Kernforschung Berlin.
RADIOAKTIVITÄT IN DER UMGEBUNG DES BER IM JAHRE 1959. (Radioactivity in the Surroundings of the

BER in 1959). W. Jacobi and H. Stephan. May 1960. 26p.

The measurements of radioactivity in air, precipitation, surface water and grass in the surroundings of the BER were continued in 1959. Mainly the total activity of fission products from nuclear weapon tests was measured. Some nuclides, especially Cs-137, were analyzed from the γ spectrum of the samples. Since the middle of 1959 the total fission product activity in air and precipitation decreased rapidly. The report contains the observed values of activity in 1959 and a comparison with the values of 1958. The operation of the reactor and the laboratories did not influence the activity in the surroundings. (auth)

20486 NP-8883

Sweden. Försvarets Forskningsanstalt, Stockholm.

THE CONTENT OF Cs 137 AND (Zr + Nb) 95 IN SWEDISH SOILS. K. Löw and K. Edvarson. May 1960. 11p.

The content of cesium-137 and zirconium-95 + niobium-95 in samples of soil gave good correlation with the precipitation in Sweden during June 1959. (C.H.)

20487 NYO-9322

Harvard Univ., Boston. School of Public Health.

RESPIRATORY PROTECTIVE EQUIPMENT. Progress Report for June 1959 to April 1960. Leslie Silverman, Joseph J. Fitzgerald, William A. Burgess, Morton Corn, and Felix Stein. June 27, 1960. 59p. Contract AT(30-1)-2355. OTS.

Improved respiratory protective equipment was developed for protection against highly toxic radioactive and non-radioactive aerosols encountered in nuclear processes. Several commercially available nebulizers were tested for generation of particles with a mean size of 0.1 to 0.5 μ. Uranine, a commercial dyestuff which is excited by light 4400 to 5000A and emits at 5700 to 5900A, was used as the aerosol. A millipore filter was chosen as the filter for collection of uranine. Two respirator designs were tested, with emphasis on the reduction or elimination of the in-leakage of toxic materials which may occur between the edge of the respirator and the face of the wearer. An exposure chamber was designed in order to expose a man wearing a respirator to the test aerosol while in a work situation. Results are presented from tests on the efficiency of existing respiratory protective equipment under sedentary and working conditions using a manikin and human subjects. Test results are tabulated. The new respiratory equipment described has not as yet been tested under operational conditions. (C.H.)

20488 RADC-TR-59-198

AMF Atomics Inc., Greenwich, Conn.

AIR TRANSPORTATION OF RADIOACTIVE MATERIALS INITIAL INVESTIGATION. (A Final Engineering Report for March 3, 1959 to October 3, 1959). A Poindexter. Oct. 1959. 205p. Project 6185. Contract AF30(602)-2007. (AD-229854; ER-7558).

A study is given of the logistics, economics, and safety aspects of air transportation of radioactive materials arising from the use of small nuclear power reactors and radioisotope energy sources. The principal radioactive materials which may be shipped in connection with the operation of small nuclear power plants are: spent reactor fuel, radioactive wastes, small radioactive components of the plant, and fresh reactor fuel. These materials are listed in decreasing order of cost and logistic effort required for shipment. All of these materials can be shipped on a C-130 airplane with little special equipment other than shielded shipping casks. One airplane can service five small reactors similar to the SM-1 in the three-month winter period during which airstrips in remote Arctic bases are operational. Shipments of these materials can be made without creating a serious radioactive hazard to the health of the public even in the event of a serious accident. Optimized shipping plans are given for the SM-1 and SL-1 reactors in remote Arctic locations. A program for putting these shipping plans in action is outlined. Preliminary designs of shipping casks and other equipment are shown. The relative merits of various materials for shielding air shipments of spent fuel were evaluated. Lead appears to be the most economical. Radioisotope energy sources up to 20 kw thermal output can be shipped to remote sites in a C-130 airplane if this is desired. Little special equipment other than shielded casks is needed for these shipments. (auth)

20489 USNRDL-TR-344(Rev.)

Naval Radiological Defense Lab., San Francisco.

CHANCE OBSERVATIONS OF FALLOUT CLOUD TRANSIT RADIATION AT OPERATION PLUMBBOB. R. L. Mather. Jan. 30, 1959. 20p.

By chance, observations of fall-out cloud transit radiation spectra were observed in the background spectra taken during Plumbbob Operation. These observations show that the cloud gamma-ray sources contain prominent lines at 1.3 and 1.5 Mev in the time interval between 18 and 200 minutes after shot time. The expected continuum of scattered gamma-ray energies below these energies is observed. Prominent lines above these energies are absent. (auth)

20490 WADC-TR-59-692

Convair, Fort Worth, Tex.

GUIDE FOR HEALTH PHYSICS PROCEDURES ON A PROPOSED NUCLEAR AIR BASE. Oct. 1959. 157p. Contract AF33(616)-5365. (AD-233450).

Based on an analysis of proposed nuclear aircraft operational base activities, a complete health physics organization is described. A series of job titles and descriptions is listed giving the job specialty, duties, responsibilities and qualifications for each person required in the organization, as well as the duties, functions, and procedures for each branch. Sample schedules for instrument calibration are included. Specific procedures are detailed for area and personnel monitoring functions, including health physics procedures for each area and building, and film dosimetry, bioassay and in vivo counting procedures. A complete program of environmental radioactivity surveillance for an area of approximately 30,000 square miles is described. Emergency procedures and practices are described, and a schedule of emergency action for a hypothetical major disaster is included. (auth)

20491 CEA-tr-A-359

LE CALCUL DE LA PROTECTION CONTRE LE RAYONNEMENT EN CHAMP ÉTENDU. (Calculation of the Protection against Radiation in an Extended Field). R. Plesch. Translated into French from Atompraxis 4, 397-402(1958). 20p.

Ordinary exponential calculations for gamma shield thickness give minimum values which cannot, in most cases, give sufficient protection since secondary radiation from Compton effects is not considered. Using the supplementary scattering factor B (dose build-up) which one can, to a good approximation, represent as a function of shield thickness, it is possible to calculate the effect of scattered radiation and obtain maximum thickness values which give adequate shielding. Two diagrams of these values are given with Pb as the shielding material. Another diagram gives equivalent thicknesses of Fe. The

use of a specific constant for each shielding problem thus allows use of the diagrams for a variety of conditions. The procedure for determining shield thickness for a complex gamma source (mixed radiation) is given, and the processes are illustrated with practical examples. (T.R.H.)

20492 JPRS-2952

PROTECTION AGAINST IRRADIATION WHEN WORKING WITH RADIOACTIVE CAPSULES. A. Ya. Berlovskii (Berlovskiy). Translated from Vestnik Rentgenol. i Radiol. 35, No. 1, 51-4(1960). 7p. OTS.

Methods for safer handling, application, sterilization, and storage of radioactive capsules which are employed in radiotherapy are described. (C.J.G.)

20493

A PROTECTIVE LEAD APRON FOR THE CAUTIOUS RADIOLOGIST. Edwin L. Lame (Presbyterian Hospital, Philadelphia). Am. J. Roentgenol., Radium Therapy Nuclear Med. 84, 357-8(1960) Aug.

Design features are described of a protective lead apron for the protection of radiologists. (C.H.)

20494

RADIATION DOSE TO THE SKIN IN ROENTGEN DIAGNOSTIC PROCEDURES. OPTIMUM KVP. AND TISSUE MEASUREMENT TECHNIQUES. Aaron P. Sanders, Kathryn Sharpe, John B. Cahoon, Robert J. Reeves, Joseph K. Isley, and George J. Baylin (Duke Univ., Durham, N. C.). Am. J. Roentgenol. Radium Therapy Nuclear Med. 84, 359-68(1960) Aug.

The radiation doses being received during various routine roentgen diagnostic procedures have been determined. These doses were determined for filtration conditions ranging from good to poor using the optimum kilovoltage technique and the tissue measurement technique. A short discussion of the results is given. (auth)

20495

SPECTROGRAPHIC DETERMINATION OF BERYLLIUM IN THE ATMOSPHERE. M. S. W. Webb (Atomic Energy Research Establishment, Woolwich Outstation, Eng.). Atom, No. 45, 20-31(1960) July.

Methods for the spectrographic determination of Be in air are reviewed. The usual method is to filter the air and analyze the filter paper. The effects of the sampling rate, filter medium, and various methods of analysis are discussed. The sampling rate should not be less than the normal breathing rate of man, and the filter medium should capture the clinically important particles of radium 0.4 to 0.8 μ. The effects of filtration velocity on % penetration of filter papers are studied. Glass fiber filters would seem to be good for this purpose, but unfortunately they contain a Be blank, and this must be eliminated for the determination of small amounts of Be. In the analysis of the filter paper, the best method is to impregnate it with ferric nitrate solution and ash it at low temperatures; the resulting ferric oxide serves both as a carrier for Be and as a spectrographic buffer. This method is further improved by using photoelectric recording in place of the lengthy photographic process and using a triggered a-c arc for better Be excitation. Solution methods of analysis of filter papers are briefly discussed. The disadvantage of the above analysis methods is that they require time, and the Churchill-Gillieson monitor, briefly described, was designed for immediate Be monitoring. However, it also has disadvantages: its response varies with particle size, and it had no provision for automatic calibration. A new monitor was therefore designed (called the Woolwich monitor) for analysis within one minute after sampling, and it is described in detail. The inefficiency of excitation of condensed sparks was overcome by a modified triggered a-c arc, whose behavior is similar to that of a d-c plasma arc; its circuit is given together with that for the recording system. Calibration is provided for by means of a spark discharge between a Cu and a Cu-Be electrode, evolving Be at a constant rate. The monitor's performance was evaluated for Be aerosols of narrow particle size ranges; the monitor was found to detect high Be concentrations of too short a duration to be detected by filtration techniques. (D.L.C.)

20496

THE MEASUREMENTS OF THE EXPOSURE DOSE RATES AROUND THE X-RAY DIFFRACTION APPARATUS. Yasuyuki Moriuchi, Tamiyoshi Kinoshita, and Keisuke Kikuchi. Denki Shikensho Ihô 24, 388-94(1960). (In Japanese)

The results of dose rate measurements around an x-ray-diffraction apparatus are presented. The measurements were carried out with a sphere-shaped thin wall ionization chamber. The dose sensitivities of this chamber were calibrated by comparison with a soft x-ray standard ionization chamber. The effective energies of the beam scattered from samples and that of the direct beam from the target were measured to be about 7 kev and 11 kev, respectively. From these measurements, it was confirmed that the exposure dose rates in the wide region near the apparatus exceeds the maximum permissible levels by far, necessitating appropriate shieldings. (auth)

20497

REMOVAL OF RADIONUCLIDES FROM THE PASCO SUPPLY BY CONVENTIONAL TREATMENT. Robert L. Junkins (General Electric Co., Richland, Wash.). J. Am. Water Works Assoc. 52, 834-40(1960) July.

Water from the Columbia River, used in cooling the Hanford Reactors and then returned to the river, was investigated as a source of radiation exposure. The distribution and removal of radionuclides from the Pasco, Washington, water supply were studied. More than 60 radionuclides were measured in HAPO reactor effluent, but Mn^{56}, Si^{31}, Cu^{64}, Zn^{69}, Na^{24}, As^{76}, Np^{239}, Cr^{51}, and Zn^{65} make up 95% of the total concentration at four hours after irradiation. At the Pasco water plant, water was pumped from the river and chemicals were added to form a flocculant precipitate of $Al(OH)_3$ which removed sediments and particulate matter by agglomeration and settling. Chlorine was added and the water was passed through large sedimentation basins and filter beds into a clear well where additional analyses were performed. The final chlorine adjustment was made as the water was pumped from the clear well to reservoirs. The facilities at Pasco were not designed and are not deliberately operated to remove radionuclides from water and sewage. The plants were proved effective in this regard, however, and no special precautions are needed because of radionuclides in water and sewage. (M.C.G.)

20498

SIGNIFICANCE OF RADIOACTIVITY IN WATER SUPPLY AND TREATMENT. Herbert A. Bevis (State Dept. of Health, Austin, Tex.). J. Am. Water Works Assoc. 52, 841-6(1960) July.

The increasing number of sources of radioactive contamination of water supplies is discussed along with a general review of the biological effects of alpha particles, beta particles, and gamma rays. The removal of radioactive materials from surface and ground waters was studied. Removals of 46% by coagulation and settling were increased to 70% with the addition of filtration. With lime-

soda ash softening, removal efficiencies were increased to 90 to 95%. In mixed beds containing both cation and anion resins, removals in excess of 99.99% were obtained. Special units to decontaminate water supplies were developed. In one unit containing beds of steel wool, clay pellets, activated carbon, and cation-anion-exchange resins in series, removals of 99.996% were obtained. (M.C.G.)

20499

THE INTERCHANGEABILITY OF THE RADIATION SOURCE AND THE OBJECT IN RADIOLOGICAL DOSIMETRY. S. N. Ardashnikov and N. S. Chetverikov. Med. Radiol. 5, No. 5, 29-33(1960) May. (In Russian)

The simplest sign and the conditions of interchangeability of the radiation source and the object of irradiation are given. The principle of interchangeability is discussed in three aspects: the point source and point object; the volumetric source and volumetric object; the point source and volumetric object. The doses of absorption at the point, the average and integral doses were taken into account. Certain errors in other works are pointed out. (auth)

20500

THE STATE OF THE NERVOUS SYSTEM OF PERSONS WORKING WITH RADIOACTIVE SUBSTANCES. A. A. Danilin, N. I. Lukash, T. Ya. Malinovskaya, R. B. Skvirskaya, V. D. Serebryannikov, and G. A. Sheshina (Central Research Inst. of Medical Radiology, Ministry of Health, USSR). Med. Radiol. 5, No. 5, 37-43(1960) May. (In Russian)

The state of the nervous system was studied for 5 years on the dispensary level in 437 persons working with radioactive substances (the total irradiation dose did not exceed 0.2 r per week) and in 210 subjects having no contact with ionizing radiation. The uniformity of the age-sex composition, length of service, and occupation of both groups made it possible to subject the results of the neurological to a quantitative-qualitative analysis by the statistical method, and give a comparative assessment of the state of the nervous system in persons of both groups. The changes of the nervous system were mainly of a functional nature and were identical in both groups; the rate of occurrence differed considerably. Various complaints and clinical symptoms of functional disorders were encountered more frequently (almost twice as often) in persons of the group examined than in the control. The arterial pressure values depended on the length of work with ionizing radiation. Chronaxie in 47 subjects of the first group and 17 of the control disclosed changes in a number of persons of the first group, testifying to a decrease of excitability of the peripheral portion of the nervous system. A lengthening of optic chronaxie in persons of the first group gives ground to assume the development of a more profound cortical inhibition, as compared with the normals. The prevalence of the incidence of nervous system affection in subjects of the studied group shows that these changes are associated with occupational hazards. (auth)

20501

ASSESSMENT OF THE RADIATION DOSE DUE TO FALLOUT. P. F. Gustafson (Argonne National Lab., Ill.). Radiology 75, 282-8(1960) Aug.

The procedures described and utilized made it possible to obtain a measure of the radiation dose arising from gamma-emitting fission activity on the ground. Evaluation of the whole-body dose to man from such a source was made with the use of shielding factors applied to this gamma radiation. It was calculated that the present situation, in which nuclear weapons testing is no longer being carried out, will lead to a thirty-year dose of 52 mrads and a lifetime dose of 62 mrads to roughly one-half the population of the United States. These are increases of approximately 1.4 and 0.7 per cent respectively over natural radiation. The continuous testing of nuclear weapons at the rate occurring between 1954 and 1959 would result in an increase of the whole-body dose of some 6 per cent over that occurring naturally. (auth)

20502

"METHOD OF CLEANING RADIOACTIVE ARTICLES." (to Bendix Aviation Corp.). British Patent 839,402. June 29, 1960.

An ultrasonic decontamination method is reported for cleaning radioactive articles. The contaminated article is cleaned by the action of ultrasonic waves in a liquid to which a detergent has been added. (W.L.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

20503 AD-233870

Quaker Oats Co. Research Labs., Barrington, Ill.

USE OF VARIOUS AMOUNTS OF RADIATION AND HEAT PROCESSING IN THE PRESERVATION OF CANNED FOODS. Report No. 12 (Progress) [for] April 1, 1959-June 30, 1959. E. F. Caldwell. 5p. Project No. 7-84-01-002. Contract QMR E (Natick) No. 15 (Agreement).

Carotene analysis of chili sauce irradiated with and without fat soluble and water soluble antioxidants showed that ascorbic acid was more effective in preventing radiation damage to carotenoid compounds than BHA at the respective levels used. Keeping the carotene compounds separated from the fat components was of greater value than using antioxidants with the ingredients mixed together. Attempts to change the ingredients of the chili to improve the flavor of the irradiated product met with no marked success. Increasing the amounts of spices other than chili powder still did not result in as flavorful a product as the heat processed chili, nor did substitution of beef heart for beef muscle add to the flavor of the irradiated product. (auth)

20504 NYO-2597

Consolidation Coal Co. Research and Development Div., Library, Penna.

UTILIZATION OF RADIOACTIVE ISOTOPES IN COAL PROCESS RESEARCH. Final Report, Task I, [Covering the period] March 1, 1959-March 31, 1960. P. M. Yavorsky and E. Gorin. Apr. 30, 1960. 97p. Contract AT(30-1)-2350. OTS.

Techniques and procedures were evaluated for the application of the Wilzbach self-tagging tritium-labeling procedure for labeling polycyclic hydrocarbon compounds of high molecular weight and natural oils of similar structure derived from coal. Methods were developed for determination of the distribution of the incorporated tritium between products of radiation damage and within the parent compound, as well as for purification of the labeled parent compound. Tagging data were obtained for a variety of model compounds and natural oils from coal. Techniques were developed for the use of tracer isotopes in the study of particle mechanics of liquid-solid fluidized systems. The specific system studied was coal fluidized by water as the liquid vehicle. Radioactive coal was used as tracer for all the studies here. Radioactivity was induced in the coal by irradiation with a high neutron flux. The utilization of tracer techniques for obtaining fundamental information on fluidized systems was demonstrated. Studies

were made of the rate of solids mixing and diffusion in fluidized beds, rate and degree of size segregation, settling rates of oversize particles, and fluidized bed expansion as functions of particle size, fluidizing vehicle velocity, and viscosity of the fluidizing vehicle. (See also NYO-2596.) (auth)

20505

EFFICIENCY OF RADIOACTIVE AND SEMICONDUCTOR MEASURING METHODS AS RELATED TO GAGES AND THE FIELD INVESTIGATED. D. Pavelescu. Acad. rep. populare Romîne, Inst. mecan. apl. "Traian Vuia," Studii cercetăr. mecan. apl. 11, 283-90(1960). (In Rumanian)

The way in which radioactive isotopes, the specific instruments, and particularly counters are suited to measurements in various fields is discussed. The fields of application for various types of semiconductor gages are also discussed. It is shown that the semiconductors are more adequate than the radioactive ones in gas flow measurements as velocities and opacities. Other applications of semiconductor gages are also indicated. It is concluded that the various methods can individually cover only certain fields. (auth)

20506

INDUSTRIAL USES OF RADIOISOTOPES. F. D. R. Butement (Univ. of Liverpool). Bol. inform. junta control energía atómica (Peru) 5, 12-20(1960) Jan.-Feb. (In Spanish)

There are numerous industrial applications of radioisotopes. The uses in thickness measurements, determination of liquid levels, detection of leaks, hydraulic problems, static tests, degassing, radiography, and sterilization of foods and medical instruments are discussed. (J.S.R.)

20507

DETERMINATION OF THERMOCOUPLE LOCATION IN REENTRY VEHICLES BY PENETRATING RADIATION. M. V. Grund (Avco Corp., Wilmington, Mass.). Nondestructive Testing 18, 258-62(1960) July-Aug..

The selection of a nondestructive test method and the development of a technique for accurate location of thermocouple junctions imbedded in stainless steel and nickel are described. The measurement of thicknesses of these materials in the range of 0.015 to 0.030 inch ±0.003 to 0.005 as a shop inspection procedure is discussed. Information is presented on the source of radiation employed, choice of detection instrumentation, and calibration procedure. Results of nondestructive measurement and correlation with destructive measurements of drilled thermocouple hole depth and geometry are presented. Consideration is also given to the accuracy and sensitivity achieved as well as the radiation safety problem. (auth)

ISOTOPE SEPARATION

20508 NYO-8769

Rutgers Univ., Newark, N. J.

SEPARATION AND EXCHANGE OF ISOTOPES. Annual Progress Report for July 1, 1959 to July 1, 1960. William Spindel, Lois Nash Kauder, E. U. Monse, Marvin J. Stern, and Paul R. Gross. 115p. Contract AT(30-1)-2250. OTS.

Studies of oxygen isotope exchange between a solution of hydrated cations and the vapor have been continued during the past year. In particular, the possibility of using the exchange equilibrium H_3O^{16+} (sol'n) + H_2O^{18} (gas) $\rightleftharpoons$ H_3O^{18+} (sol'n) + H_2O^{16} (gas) for concentrating oxygen isotopes by distilling azeotropic acid solutions has been investigated. Experiments were carried out in a distillation column (65 cm. long by 13mm i.d.) packed with tantalum wire helices, to compare over-all separation (depletion in the vapor phase) for azeotropic acid solutions and pure water. The separations obtained using hydrochloric and hydrobromic acid solutions were considerably larger than for water at comparable conditions; operating at atmospheric pressure and a flow rate of about 65 ml/min typical separations obtained were: 1.75 for 8.6 M Hbr, 1.63 for 6.1 M HCl, 1.23 for 15.3 M HNO_3 and 1.36 for pure water. Relative fractionation factors obtained from Rayleigh distillations and column studies were: H_2O, 1.005 at 100°C and 1.010 at 424°C; 6.1 M HCl, 1.009 at 110°C and 1.014 at 45°C; 8.6 M HBr, 1.010 at 126°C; 15.3 M HNO_3, 1.006 at 121°C. Further experiments on atomic exchange between isotopically labelled nitric oxide molecules have indicated that exchange is complete in less than 15 to 30 seconds at room temperature and gas pressures of about 2cm. Hg in the presence of only slight traces of higher oxides. The exchange rate was about 100 to 1000 times slower at a much lower gas pressure of 60 to 100 microns Hg, and was increased by adding appreciable amounts of oxygen. Freezing the gas mixture in liquid nitrogen and re-evaporating it did not affect the extent of exchange, indicating that the dimer formed in solid nitric oxide does not have a square structure involving N–O bridges such as: $\begin{matrix} N-O \\ | \quad | \\ O-N \end{matrix}$. The exchange of C^{13} between nickel carbonyl and carbon monoxide has been explored. The effective separation factor at atmospheric pressure and −16°C is 1.017 ± 0.002. Preliminary studies in a packed column indicate that the exchange rate is too slow to yield short stage heights at reasonable interstage flow rates. The single-stage separation factor for nitrogen-15 between nitric oxide and nitrate solutions was measured as a function of temperature over the range 25 to 75°C. In dilute nitric acid solutions and neutral solutions of nitrate salts, the measured separation factors are in agreement with values estimated from spectroscopic data for nitrate ion. Calculations of partition function ratios for isotopic exchanges involving oxides of nitrogen were carried out. The equilibrium constant calculated for exchange of nitrogen-15 between N_2O_4 and NO is higher than the corresponding value for exchange between N_2O_3 and NO. This indicates that separation of heavy nitrogen by exchange between NO and liquid nitrogen oxides may be improved at higher pressures. Studies were carried out on the effect of deuterium on cell division processes. Although high concentrations of deuterium arrest division in fertilized eggs of the sea urchin, Arbacia Punctulatus, the blockage was reversed by returning eggs to a light water medium after immersion in heavy water for a period of about an hour. Evidence of multiple and rapid divisions in cells after treatment in D_2O suggests that some metabolic processes and chromosome duplication continues while cells are immersed in heavy water. (auth)

20509 JPRS-2476

ON THE COMPUTATION OF A SINGLE COEFFICIENT OF THE SEPARATION OF ISOTOPES FOR EQUILIBRIUM PROCESSES. Ye. M. Kuznetsova, A. V. Makarov, and G. M. Panchenkov. Translated from Zhur. Fiz. Khim. 32, 2641-3(1958). 4p. OTS.

An analysis is given of a method of computing the single-stage separation factor for isotope separation by equilibrium methods. (T.R.H.)

20510 JPRS-2477

THE SEPARATION OF BORON ISOTOPES BY THERMODIFFUSION. G. M. Panchenkov, V. D. Moiseev (Moiseyev), and Yu. A. Lebedev. Translated from Zhur. Fiz. Khim. 30, 2348-52(1956). OTS.

An investigation was made to evaluate thermodiffusion of BF_3 below atmospheric pressure for separating B isotopes. The cascade is described and the experimental procedure outlined. The process was not found to be effective. Theoretical results were not obtained. (T.R.H.)

20511 JPRS-2779

THE CHEMISTRY AND SEPARATION OF ISOTOPES. G. M. Panchenkov, I. A. Semiokhin, and P. A. Akishin. Translated from Vestnik Moskov. Univ., Ser. Mat. i Mekhan., Astron., Fiz. i Khim. 12, No. 6, 199-214(1957). 23p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 5328.

20512

THE SEPARATION POTENTIAL OF THERMALLY CONTROLLED COUNTERCURRENT GAS CENTRIFUGES. II. UNSYMMETRICAL SEPARATION PROCESS. W. Bulang, W. Groth, I. Jordan, W. Kolbe, E. Nann, and K. H. Welge (Universität, Bonn). Z. physik. Chem. (Frankfurt) (N.S.) 24, 249-64(1960) May. (In German)

In an earlier article (Z. Phys. Chem. 19, 1(1959)) the separation potential of thermally controlled countercurrent centrifuges was reported for the case of symmetrical separation processes. The theory and the separation research was extended to the case of unsymmetrical separation processes. The results, significant for the practical purposes of isotope separation, show that the maximum separation potential is not attained at $\theta = 0.5$ (symmetrical separation process) but at $0.3 < \theta < 0.4$. At this extraction ratio the enrichment of the light fraction is considerably greater than in the symmetrical case (θ = molar current of light fraction : total molar current). (tr-auth)

20513

PROCESS FOR THE PRODUCTION OF WATER ENRICHED IN DEUTERIUM OXIDE. (to United Kingdom Atomic Energy Authority). British Patent 837,730. June 15, 1960.

A method is reported for the production of heavy water. The method consists of contacting alkali-catalyzed water with a mercaptan or hydrogen sulfide in a countercurrent system with two stages maintained at different temperatures. The water enriched in deuterium oxide is withdrawn from a point between the two stages. (W.L.H.)

MATHEMATICS AND COMPUTERS

20514 HW-63576(p.10-16)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A SUBROUTINE TO CALCULATE THE INCOMPLETE GAMMA FUNCTION. J. E. Schlosser. p.10-16 of NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959.

Because of the interest in incomplete gamma functions, a subroutine was written to compute its values. In order to obtain increased accuracy with the calculated functions three methods are used. The methods involve: (a) power series, (b) continued fraction, and (c) asymptotic series. (auth)

20515 HW-63576(p.17-19)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A SUBROUTINE TO CALCULATE THE GAMMA FUNCTION. J. E. Schlosser. p.17-19 of NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959.

An IBM-709 FORTRAN subroutine to calculate the complete gamma function for real argument was written and tested. The method used to calculate the gamma function is a modification of the asymptotic expression. (W.D.M.)

20516 HW-63576(p.20-5)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A SUBROUTINE TO CALCULATE EXPONENTIAL INTEGRALS. J. E. Schlosser. p.20-5 of NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959.

A FORTRAN language subroutine which calculates the exponential integral was completed. Three calculational procedures are used in the code in order to obtain increased accuracy. The method chosen for calculation depends upon the size of the argument: a power series for small arguments, a continued fraction in the intermediate range, and an asymptotic series for large arguments. (auth)

20517 SCR-195

Illinois. Univ., Urbana.

RECENT RESULTS IN INFORMATION THEORY. Emiel Feinstein. June 1960. 25p. OTS.

A discussion is presented in which the nature of some problems with which information theory concerns itself is defined. Some of the more recent results are also discussed. (J.R.D.)

20518

ELECTRONIC COMPUTERS AND NUCLEAR ENGINEERING RESEARCH. J. Patry (Reaktor S. A., Würenlingen, Switzerland). Neue Technik 1, No. 2, 3-7(1959) June. (In French)

It is impossible to work efficiently in nuclear research without the use of a computer. The various types of computers and their characteristic properties are investigated as well as the needs of nuclear research from this point of view. It follows from this investigation, that the computer must have a big memory which in turn requires a fairly big staff. The conclusion is that organizing only one computing center which cooperates closely with all the existing centers, seems to be the best solution in Switzerland. (auth)

20519

THE USE OF AN ELECTRONIC COMPUTER FOR SOLUTION OF TECHNICAL-SCIENTIFIC PROBLEMS (WITH SPECIAL REFERENCE TO NUCLEAR ENGINEERING). J. Patry (Reaktor A. G., Würenlingen, Switzerland). Neue Technik 2, No. 4, 3-11(1960) Apr. (In German)

The Reactor Ltd. will be using soon a Z 22 computer. It is therefore necessary to know which problems can be solved with advantage on this computer and which ones will be rather solved on a desk-computing-machine. A few examples show that programming-work is often very difficult and, consequently, takes a lot of time. (auth)

20520

COMPUTER FOR THE IDENTIFICATION OF CHARGED PARTICLES. Richard H. Stokes (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr. 31, 768-72(1960) July.

An improved computer circuit is described which can be used with appropriate counters to identify charged particles. Previously this system was used to identify protons, deuterons, and tritons. More recently the computer was used to separate He^3 and He^4 events. A sample calculation of the performance is given which shows that He^3 and He^4 events can be distinguished over a wide energy range with a single choice of computer parameters. Consideration is also given to the use of the method for low energy particles. It is concluded that, with easily attain-

able counter resolution, protons can be identified at energies extending below 1 Mev. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

20521 AD-232938

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

DEVELOPMENT OF COBALT-BASE ALLOYS. Progress Report No. 4 [for] April 1–May 31, 1958. John J. Rausch. June 27, 1958. 22p. Project No. B 131. Contract NOas 58-136-c.

The results of forging studies on cobalt-base alloys are tabulated. Several binary alloys containing aluminum, boron, and chromium were prepared. All alloys except Co-2B were forged successfully. Ternary alloys based on Co–Cr were also prepared using high-purity chromium. Tensile test results are also tabulated. Several binary alloys were studied to supplement the data already obtained on materials of this type. Ternary compositions such as Co–20Cr–15Mo, Co–15Mo–3Ta, Co–10Ti–1Nb, and Co–10Ti–3Ta showed outstanding strength at 1700°. The alloys based on Co-30Cr and Co-Ti are in general not forgeable. Results of forging studies and oxidation tests are tabulated, and data on yield strength are presented graphically. (J.R.D.)

20522 NDA-2145-4

Nuclear Development Corp. of America, White Plains, N. Y. and Carborundum Co., Niagara Falls, N. Y.

CARBIDE FUEL DEVELOPMENT. Progress Report [for] February 1, 1960 to April 30, 1960. A. Strasser and K. Taylor. June 13, 1960. 13p. Contract AT(30-1)-2303. OTS.

The relationship of cold forming pressure, sintering time, and temperature to final UC pellet density was studied. Excess uranium was added in dense UC experimental preparation by hot pressing mixtures of carbon and uranium; however, the densities were no higher than those previously obtained. Fabrication of enriched UC is scheduled to start soon, and work on natural UC will at the same time be stopped. Compatability tests between UC and cladding materials were continued. Niobium was found to be inert, 304 stainless slightly reactive, and Inconel-X strongly reactive in tests at 820°C for 2000 hours. PuO_2 is being prepared for starting material in preparation of PuC. Prototype fabrication of irradiation components was started, and a prototype of the pressure probe for in-pile fission gas release measurement was assembled and calibrated. A description of the construction status of the plutonium facility is included. (For preceding period see NDA-2145-1.) (J.R.D.)

20523 NMI-2085

Nuclear Metals, Inc., Concord, Mass.

FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for March 1960. June 13, 1960. 39p. Contract AT(30-1)-1565. OTS.

In the development of Be-clad U research was performed on the following: roll cladding of U–UC with Be, dimensional stability of U–UC cermet, induction melting of U–UC ingot, and extrusion cladding of epsilon U with Be. A total of sixteen vacuum-fusion samples were prepared from the cylindrical stacks and disks of the glow-discharge samples. A summary of the vacuum-fusion runs is given. Studies were made on the stability of the beta phase in U–0.3 wt.% Cr–0.3 wt.% Mo alloy and the determination of transformation kinetics of the U–0.3 wt.% Cr alloy by measuring changes in electrical resistance during isothermal transformation of the beta phase at temperatures between 400 and 500°C. The preparation and thermal analysis are reported for Be–Pd, Be–Pt, Be–V, and Be–Ni–Pd alloys. Aging, metallographic, and x-ray data were obtained on selected samples of Be. Work is continuing to determine the order of magnitude of the isotopic interchange which would occur in dispersion-type fuel elements having a matrix of fertile material. Two crystals of UO_2 deformed in compression at ~800°C showed strong evidence of [100] slip from analysis of the observed deformation traces. (For preceding period see NMI-2084.) (W.L.H.)

20524 NMI-2086

Nuclear Metals, Inc., Concord, Mass.

FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for April 1960. June 15, 1960. 33p. Contract AT(30-1)-1565. OTS.

In the Be-clad U program investigations were continued on the extrusion cladding of U–10 wt.% Mo, dimensional stability on thermal cycling of extrusion clad rods, and melting of U–UC. Gas analysis for the glow-discharge samples is summarized. In the program to develop metastable beta-phase U-base alloys, emphasis was placed upon a study of the transformation of the retained beta phase during isothermal annealing in the temperature range 400 to 500°C. The preparation and thermal analysis of Be–Ce, Be–Cr, and Be–La alloys are reported. Values of the diffusion coefficient of U in UO_2 were calculated for two sets of experimental data in which the surface alpha counting rate was measured as a function of distance on a disc of natural UO_2 which had been heated in contact with molten enriched U at 1200°C. Three UO_2 crystals were polished, deformed, and analyzed. (For preceding period, see NMI-2085.) (W.L.H.)

20525 NP-8752

Battelle Memorial Inst., Columbus, Ohio.

DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. M. J. Wahll, comp. May 1960. 129p.

A current listing of selected documents and journal articles is presented on light metals, titanium, beryllium, boron, refractory metals, molybdenum, niobium, tantalum, chromium, tungsten, the platinum group, steels, and high-strength alloys. Also included are listings of reports of special metal applications, coatings, fabrications, nonmetallic refractories, properties, and thermal protection. (M.C.G.)

20526 ORNL-2184

Oak Ridge National Lab., Tenn.

ALLOYING OF ZIRCONIUM-CONTAINING FUELS WITH ZINC AND MAGNESIUM. R. G. Wymer. May 24, 1957. Decl. Mar. 30, 1960. 13p. Contract W-7405-eng-26. OTS.

Zr–U alloys dissolved readily in molten Zn (>800°C), but the resulting alloy did not dissolve completely in nitric acid. The fraction of U remaining in the solids was lower with higher Zn/Zr ratios or when another metal, e.g., Mg, was added to the melt. In the latter case, U retention by the insoluble residue was as low as 0.3%, compared to at least 6% when molten zinc alone was added. (auth)

20527 ORNL-2947(p.75-81)
Oak Ridge National Lab., Tenn.
ENGINEERING AND PHYSICAL PROPERTIES. H. W. Hoffman, et al. p.75-81 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

Previous studies of the minimum velocity required to transport flocculated suspensions in horizontal pipes have shown two regions of flow, depending on the concentration. The critical concentration for the transition from one type of flow to the other is shown to be a function of degree of flocculation and tube diameter. It is also shown that the critical concentration can be determined from a systematic study of the hindered-settling rate as a function of container diameter and suspension concentration. An analysis of the minimum-transport condition for particles sufficiently small to settle according to Stokes' law and with diameters smaller than the thickness of the laminar sublayer has shown that at least two forces act on the particle causing it to be transported. The first condition results from the particle settling through a fluid having a velocity gradient. The difference in stream velocity between the top and bottom of the particle results in a pressure difference between the top and bottom of the particle. The net force at the minimum-transport condition was found to be just equal to the gravitational force on the particle. The other condition results from application of the penetration theory in which turbulent eddies are postulated as penetrating through the laminar sublayer to the pipe wall. It was found that at the minimum-transport condition the magnitude of the fluctuations one particle diameter from the wall is just equal to the settling rate of the particle. Tests have shown that Li_2SO_4 is an effective dispersant of thoria suspensions even at temperatures as great as 250°C. Therefore, a run was made in a high-temperature loop to determine whether the presence of Li_2SO_4 would prevent cake deposition when ThO_2 spheres, known to be cake formers, were circulated. The test was more favorable than any previous tests with different electrolytes and indicated that selection of the proper concentration of Li_2SO_4 might result in a marked decrease in caking tendency. Addition of 50 wt.% noncaking oxide to a known caking oxide decreased but did not prevent the formation of deposits in the loop. Coprecipitation of 0.05 to 0.25 mole fraction Zr, Al, and Pb with thorium followed by calcination at 800°C increased particle integrity greatly over that observed with oxides prepared in a similar manner except that metal oxide additives were not present. (auth)

20528 ORNL-2947(p.113-17)
Oak Ridge National Lab., Tenn.
THORIUM OXIDE PREPARATION. O. C. Dean, P. A. Haas, et al. p.113-17 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

Three 3-kg batches of spheroidal thoria pellets of ~0.2 in. diameter, 9.6 to 9.7 g/cc density, and having good resistance to attrition in a spouting bed test were prepared for feasibility studies for the pebble-bed blanket. The best results were obtained from oxalate powder which had been prepared by precipitation under oxalate-deficient conditions and had then been fired to 800°C for 1 hr. It was pressed to a green density of 4.5 g/cc with aluminum stearate binder and then fired to 1750°C in air. Four kilograms of 1450°C-fired Davison pellets of low density, strength, and attrition resistance were densified, strengthened, and hardened to a satisfactory degree by soaking in diban (dibasic aluminum nitrate solution) and then firing to 1750°C. The average size of thoria microspheres prepared by the flame denitration of methanol solutions of thorium nitrate tetrahydrate was not changed by increasing the size of the droplets fed to the combustion zone or by substituting water for methanol and nitrogen for propane-oxygen for atomizing the feed solution. Decreasing the reflector temperature in the combustion zone from 1600 to 900°C doubled the average particle size, increasing it from 1 μ to 2 μ. (auth)

20529 SEP-135(Rev.)
Sylvania Electric Products Inc., [Atomic Energy Div.], Bayside, N. Y.
URANIUM METAL QUALITY TESTING PROGRAM. Progress Report I. Nicholas Grossman. Oct. 28, 1953. Decl. Feb. 16, 1960. 85p. Contract AT-30-1-GEN-366. OTS.

Preliminary data are reported from studies of factors affecting U metal quality. A detailed description of testing techniques employed and test results are presented for a low density rolled slug, 24 rolled slugs with known casting and mill histories, and two production ingot castings using different feed metals. Testing techniques employed during this investigation included the following: Surface testing by visual examination, Zyglo and Spotcheck, macroetch, eddy current testing (orthogonal probe analysis), autoradiography (Eastman Kodak ortho process-X), and compression testing of short cylinders. Density determinations, in addition to standard testing by the Archimedes method, were made by radial density studies and by ultrasonic testing (Sperry Reflectoscope with pulse technique). Standard testing methods were used for the physical and mechanical testing, and in addition a macrohardness test was performed by the Bergsman Indentor. Structural analysis was determined by microscopic examination for grain structure and inclusions along with qualitative spectrographic analysis and quantitative chemical analysis, x-ray diffraction, and notched bar bend tests. (C.H.)

20530 AEC-tr-4130
METALLOGRAPHIC PREPARATION OF NOBLE METAL SAMPLES BY ELECTROLYTIC LAPPING. (Metallographische Praparation von Edelmetallproben durch Elektrolytisches Wischpolieren). Gerhard Reinacher. Translated for Oak Ridge National Lab. from Z. Metallk. 48, 162-70 (1957). 30p. (Includes original, 9p.). JCL.

A method of polishing noble metals by a combination of anodic polishing and mechanical lapping of the samples in a thiosulfate electrolyte is described. The method permits polishing of heterogeneous materials without preferentially dissolving the baser plane. The method speeds up difficult structure development and increases the reliability. (C.J.G.)

20531 CEA-tr-R-839
APPAREIL POUR L'ATTAQUE DES MÉTAUX PAR BOMBARDMENT IONIQUE—UIT-1. (Apparatus for Etching of Metals by Ion Bombardment—UIT-1). G. V. Spivak, V. Ye. Yurasova (V. E. Yurassova), F. P. Kushnir, and I. N. Prilezhayeva. Translated into French from Pribory i Tekh. Ekspt. No. 2, 106-10(1957). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 8466.

20532 JPRS-2901
PRODUCTION AND THE PHYSICAL METALLURGY OF PURE METALS. PART IV. INVESTIGATION OF THE PROCESS OF THERMAL REDUCTION OF BeF_2 WITH MAGNESIUM. A. I. Evstyukhin (Yevstyukhin). Translated from Met. i Metalloved. Chistykh Metallov No. 1, 91-105 (1959). 18p. OTS.

A brief characterization of the state of Be metallurgy is

given. A thermodynamic calculation for reducing BeF by Mg was made, and the mechanics of the reduction are discussed in connection with phase changes in the initial charge. An experimental study of the state diagram in binary system BeF_2-MgF_2 was carried out for the purpose of selecting a rational composition for the slag to be used in Mg thermal reduction of BeF_2 which uses an excess of BeF_2 as a flux-forming component. The influence of the nature of the slag on the mechanics and kinetics of BeF_2 reduction by Mg is discussed. (W.L.H.)

20533

MATERIALS AND WELDING IN REACTOR CONSTRUCTION. [PART I]. R. Nass (Arbeitsgemeinschaft BBC/Krupp, Ger.). Atomwirtschaft 6, 257-64(1960) June. (In German)

Reactor construction materials must meet special requirements, especially with respect to their neutron absorption and radiation properties. Additional specifications are necessary for components such as pressure vessels, reactor buildings, fuel element claddings, heat exchangers, and circulation systems. The special materials and alloys used are given, and their properties are indicated. (J.S.R.)

20534

A NEW PHASE OF THE URANIUM–SELENIUM SYSTEM, THE SELENIDE U_3Se_4, AND ITS CHEMICAL NATURE. Parviz Khodadad (Laboratoire de Chimie Minérale, Faculté de Pharmacie, Paris). Compt. rend. 250, 3998-4000(1960) June 13. (In French)

If U_2Se_3 or one of the other compounds in the series is heated to 1350°C at a pressure below 0.001 mm Hg for an hour and then held at 1400°C for two hours, a new phase appears. This phase has the formula U_3Se_4. It forms very brilliant black crystals with a lattice parameter a = 8.804 A. The experimental density is 10.07. U_3Se_4 is attacked readily even by dilute hydrochloric and acetic acids. (J.S.R.)

20535

ELECTRON DIFFRACTION AND ELECTRON MICROSCOPE INVESTIGATION OF THE DIFFUSION OF CARBON IN IRON AND ALUMINUM. J. J. Trillat, L. Tertian, and M. Bonnet-Gros (Centre National de la Recherche Scientifique, Bellevue, France). Mém. sci. rev. mét. 57, 81-7 (1960) Feb. (In French)

Inside an electron microscope or electron-diffraction camera under high vacuum a thin film of iron was evaporated on to a carbon membrane. The composite film was then heated to 1,000°C and its transformation studied as a function of time and temperature. It is then possible to study at any moment, and in a continuous manner the diffusion of carbon in iron in the complete absence of oxidation. The conditions of formation and stability range of the compounds which are formed (Hägg's carbide Fe_2C and cementite Fe_3C) are revealed, as well as their decomposition. An iron deposit on a polyethylene membrane heated in vacuo also produces cementite, the carbon now coming from the decomposition of the polymerized hydrocarbon. Analogous results have been obtained in the case of the diffusion of carbon in aluminum. The carbide C_3Al_4 has been thus identified. (auth)

20536

CONTRIBUTION TO THE STUDY OF THE BEHAVIOR OF HYDROGEN IN STEEL. Wilhelm Hofmann and Gerwig Vibrans. Mém. sci. rev. mét. 57, 88-90(1960) Feb. (In French)

A killed steel containing 0.22% C was saturated under pressure with hydrogen between 200 and 700°C. The values for the solubility at 200 and 300°C fall above the extrapolated curve previously published. This difference can be explained by supposing that there exists in the metal a volume of porosity of the order of 0.1%. The fatigue strength of steel containing hydrogen is only very slightly reduced, if indeed it is reduced at all, by comparison with that of hydrogen-free steel. Certain irreversible injuries to the fatigue value of the steel result from cold deformation after hydrogen solution. The same phenomenon can occur during the cooling of a weld rich in hydrogen. (auth)

20537

CONTRIBUTION TO THE STUDY OF THE DIFFUSION AND LOCALIZATION OF HYDROGEN IN A DEAD-MILD STEEL. CONSEQUENCES FOR EMBRITTLEMENT. Jacques Plusquellec. Mém. sci. rev. mét. 57, 215-31(1960) Mar. (In French)

The development of an electrolytic charging method has made it possible to determine the diffusion coefficient for hydrogen in a dead-mild steel. It was also possible to reveal, by radiocrystallography, the presence of hydrogen on the (112) planes and in the defects attached to these families of planes. These results are confirmed by mechanical tests bringing these planes into play (study of twinned specimens) or alternatively eliminating them (deformation at low temperatures). A theory is advanced according to which embrittlement is explained by the momentary flow of protons brought about by dislocations which have just piled up in front of an obstacle. (auth)

20538

CONTRIBUTION TO THE STUDY OF THE DIFFUSION AND LOCALIZATION OF HYDROGEN IN A DEAD-MILD STEEL. CONSEQUENCES FOR EMBRITTLEMENT (CONCLUSION). Jacques Plusquellec. Mém. sci. rev. mét. 57, 265-77(1960) Apr. (In French)

The development of an electrolytic charging method made it possible to determine the diffusion coefficient for hydrogen in a dead-mild steel. It was also possible to reveal, by radiocrystallography, the presence of hydrogen on the (112) planes and in the defects attached to these families of planes. These results are confirmed by mechanical tests bringing these planes into play (study of twinned specimens) or alternatively eliminating them (deformation at low temperatures). A theory is advanced according to which embrittlement is explained by the momentary flow of protons brought about by dislocations which have just piled up in front of an obstacle. (auth)

20539

A SIMPLE METHOD TO STUDY THE DIFFUSION BETWEEN TWO METALS ONE OF WHICH IS VOLATILE AND NOT VERY SOLUBLE IN THE OTHER. Y. Adda, V. Lévy, Z. Hadari, and J. Tournier (Centre d'Études Nucléaires, Saclay, France). Mém. sci. rev. mét. 57, 278-84(1960) Apr. (In French)

Micrographic studies of the dissolution of a volatile B metal rich phase into an heterogeneous (AB) alloy may lead to a simple and accurate method to determine the diffusion coefficients of B in A. This method was applied to the diffusion of strontium and lanthanum in uranium. (auth)

20540

CONTRIBUTION TO THE STUDY OF THE SOLIDIFICATION OF ALLOYS. A. Kohn and J. Philibert (Institut de Recherches de la Sidérurgie, Saint-Germain-en-Laye, France). Mém. sci. rev. mét. 57, 291-312(1960) Apr. (In French)

This investigation was carried out on light alloys, particularly on aluminum-copper alloys containing 1.2% copper: it was effected by the simultaneous employment of a

highly sensitive thermal analysis method, autoradiographic examination of specimens quenched during the course of freezing and by the Castaing microsonde analysis. The results obtained have clearly shown that solidification took place by the growth of distinct crystals of uniform chemical composition, surrounded by a film of liquid enriched in the alloying element, while the general bulk of the liquid metal preserved its original concentration; during the course of this stage of solidification the temperature undergoes little variation. By contrast, the solidification of the interdendritic liquid, which is very greatly enriched in the alloying element, occurs over a very long interval of temperature. (auth)

20541

NUCLEAR PROBLEMS HANDLED WITH X-RAYS. Robert J. Murphy (M & C Nuclear, Inc., Attleboro, Mass.). Nondestructive Testing 18, 255-7(1960) July-Aug.

X rays were adopted for use in analyses of uranium fuel alloy ingots, stainless steels, silver–gold alloys, uranium dioxide–stainless steel powder blends, and hafnium reactor control rods in the M & C Nuclear laboratories. X-ray analysis required less time, space, and fewer people than the conventional wet chemistry methods. Standards were analyzed on the x-ray spectrograph and values plotted to provide working curves. For example, when the x-ray counting rate was obtained on an unknown sample, the apparent weight-percent of uranium could be determined directly from the curve. (M.C.G.)

20542

ANALYSIS OF THE RESIDUAL GAS ON METALLIC FILMS VAPOR DEPOSITED IN ULTRAHIGH VACUUM BY MEANS OF THE OMEGATRON. H. Gentsch (Technische Hochschule, Hanover). Z. physik. Chem. (Frankfurt) (N.S.) 24, 55-65(1960) Apr. (In German)

The Omegatron, a mass spectrometer built on the cyclotron principle, is suitable for gas analysis in the pressure range form 10^{-6} to 10^{-10} Torr total pressure. The construction and operation of the Omegatron are briefly reported. The residual gas mixture on iron, nickel, and platinum films vapor deposited in ultrahigh vacuum at 20, 100, and 200°C was analyzed. The analyses give information on which gases are concerned in the slight precoating of the metal film and which temperatures selected for the annealing process are most favorable when the degree of precoating should remain small. (tr-auth)

20543

THE OXIDATION OF TITANIUM CARBIDE. E. Nikolaiski (Universität, Frankfurt am Main). Z. physik. Chem. (Frankfurt) (N.S.) 24, 405-17(1960) June. (In German)

The oxidation at the surface layers of titanium carbide was investigated. As samples small plates of aluminum oxide with titanium carbide covering one side were used. The plotting of the scale isotherm was made from measurement of the weight variation of the sample in oxidation. The isotherms show a parabolic pattern and are represented by $t = ay^2$, in which t is the reaction time, y is the weight variation, and a is a temperature-dependent constant. From the parabolic relationship it results that in the oxidation of titanium carbide a diffusion process is the velocity determining step. This can be explained if it is assumed that oxygen ions diffuse through the scale layer formed. The parabolic velocity constant calculated from the constant a follows the Arrhenius equation with an activation energy of 46,100 cal. X-ray studies of the oxide layer show that TiO_2 (rutile) occurs as the only reaction product on the titanium carbide layer. TiO or Ti_2O_5 can not be detected. For clarification of the location of the non-metallic components in the gas phase, gas samples were prepared in a special apparatus for mass spectrographic investigation. The qualitative investigation of these samples in the mass spectrograph showed a slight increase of the CO concentration at temperatures over 900°C. (tr-auth)

20544

TRANSACTIONS OF THE VACUUM METALLURGY CONFERENCE, 1959. Rointan F. Bunshah, ed. New York, New York University Press, 1960. 219p. $7.50.

Papers presented at the third Vacuum Metallurgy Conference at New York University, June 1 to 3, 1959, are collected in this volume. In addition, a paper from the second conference, "The Degassing of Steel by the Vacuum Stream-Droplet Process" by A. Tix and W. Coupette was included. "A Bibliography on the Application of Electron-Beam Techniques in Metallurgy" is also presented in recognition of the rapid growth of interest in this area. Nine of the twenty three papers are covered by separate abstracts. (M.C.G.)

20545

ARC-MELTING PROCEDURES FOR REFRACTORY METALS. M. L. Torti (National Research Corp., Cambridge, Mass.). p.1-4 of "Transactions of the Vacuum Metallurgy Conference, 1959." Rointan F. Bunshah, ed. New York, New York University Press, 1960.

Cold-mold arc melting of tungsten, tantalum, molybdenum, and niobium was studied. It was found extremely important that pumps be properly selected to handle the gas evolution of impurities while maintaining the desired degree of vacuum. Melt rate into a given mold size was varied widely by changing the diameter or density of the consumable electrode. Since melt rate affected the removal of volatile impurities, it was held as low as practical for greater removal efficiency. Power requirements were found to be higher for the refractory metals. Therefore, the cold-mold designs were different for these metals. (M.C.G.)

20546

VACUUM-ARC-MELTING STUDY OF ZIRCALOY-2. J. H. Hart (Westinghouse Electric Corp., Pittsburgh). p.30-9 of "Transactions of the Vacuum Metallurgy Conference, 1959." Rointan F. Bunshah, ed. New York, New York University Press, 1960.

Zircaloy-2 ingots were produced by double vacuum arc melting at less than 0.3 mm to provide a product with consistent properties. The vacuum-melted zircaloy-2 was consistently free of stringers and had uniform welding characteristics, corrosion resistance, and chemical content. The melting rate increased as the melting pressure was decreased. Results of corrosion tests and ingot evaluations indicated that the amount of stringing and fusion-weld penetration depended on the average melting pressure and the initial amount of chloride in the sponge. The amount of hydrogen retained in the ingot decreased as the average melting pressure decreased. (M.C.G.)

20547

THE ARC MELTING OF THORIUM ALLOYS. Phillip D. Corzine (Nuclear Metals, Inc., Concord, Mass.). p.40-8 of "Transactions of the Vacuum Metallurgy Conference, 1959. Rointan F. Bunshah, ed. New York, New York University Press, 1960.

The arc melting of thorium–uranium alloys was investigated in the range of 5 to 10 wt.% Th in order to evaluate the process as a method of producing thorium–uranium alloy ingots suitable for fabrication into fuel elements. None of the arc-melted ingots exhibited the homogeneity desired nor matched the yield of in-specification metal produced by

induction melting and casting. Surfaces of ingots cast into graphite sleeves were superior to those cast into copper. The cored electrode was not as satisfactory as the uranium in milled slots. Burn-off shapes, in both cases, revealed that the uranium melted faster than the thorium. Double-melted ingots were not superior to single-melt ingots. (M.C.G.)

20548

VACUUM A MUST IN REFRACTORY-ALLOYS DEVELOPMENT. Ernst G. Huschke, Jr. and William A. Hendricks (General Electric Co., Cincinnati). p.189-97 of "Transactions of the Vacuum Metallurgy Conference, 1959." Rointan F. Bunshah, ed. New York, New York University Press, 1960.

Some of the unique methods and vacuum metallurgical equipment necessary in current research and development work on refractory metals and their alloys are discussed. For the most part, experimental refractory-alloy compositions were initially melted as small buttons. Single or multistation nonconsumable-electrode furnaces were built for this purpose. Experimental alloys were also made in vacuum by induction melting, sintering, and levitation melting. Several types of vacuum metallurgical equipment were necessary to evaluate experimental alloy composition. Electron microscopes and hot hardness testers operated under high vacuums. There was a need for suitable high-temperature, heat-treating equipment. Vacuum furnaces to go to 5,000°F were built with tungsten heating elements. Refractory-metal thermocouple combinations were developed for temperatures to 4,600°F. For testing applications above 2,300°F, small radiant-shield vacuum furnaces were used. Experimental work to apply the electron beam principle to welding high-temperature materials in vacuum was successful. (M.C.G.)

20549

A BIBLIOGRAPHY ON THE APPLICATION OF ELECTRON-BEAM TECHNIQUES IN METALLURGY. R. F. Bunshah (New York Univ.). p.209-12 of "Transactions of the Vacuum Metallurgy Conference, 1959." Rointan F. Bunshah, ed. New York, New York University Press, 1960.

A bibliography was compiled of literature resulting from the applications of electron-beam techniques in various areas of metallurgical and allied fields. The listing was divided into five sections: General and Miscellaneous References, Melting, Welding, Zone Purification and Crystal Growth, and Evaporation. (M.C.G.)

20550

THE PRODUCTION OF DOUBLE FLUORIDES OF TITANIUM AND ZIRCONIUM WITH ALKALI METALS AND THE ELECTROLYTIC DEPOSITION OF TITANIUM AND ZIRCONIUM. Robert Lewis Bickerdike and Gerald Taylor Brown (to Peter Spence & Sons Ltd.). British Patent 834,792.

A process is described for the preparation of an alkali metal fluotitanate or fluozirconate by reacting a molten alkali metal fluoride with $TiCl_4$ or $ZrCl_4$ in the absence of water and gaseous contaminants. The resulting fluotitanate or fluozirconate is mixed with an alkali metal halide and electrolyzed to give ductile Ti or Zr metal. (W.L.H.)

Corrosion

20551 AECU-4633

Battelle Memorial Inst., Columbus, Ohio.

CORROSION OF INOR-8 AND INCONEL DISSOLVER COMPONENTS OF THE FLUORIDE-VOLATILITY PROCESS. F. W. Fink. Dec. 30, 1959. 50p. OTS.

The corrosion of INOR-8 and Inconel dissolver components used in the fluoride volatility process for the dissolution of zirconium with anhydrous HF in molten salts was investigated. Ten dissolution runs were made using simulated subassemblies formed from Zircaloy-2. The dissolver and components were made from INOR-8. Both the dissolver vessel and draft tube were examined several times during the series of runs. The solids which formed at different areas in the system were also analyzed. The results showed that the corrosion of the INOR-8 dissolver was greatest at the salt-off gas interface and at the HF gas inlet. Almost all of the corrosion took place during run 10 when no zirconium was present. Portions of the dissolver were cleaned after run 10 and sent to BMI for evaluation. The results of the Battelle metallographic examinations of the portions are included along with several photographs. The results with Inconel tubes in the copper-lined hydrofluorinator confirmed the observations that the liquid gas interface areas were most susceptible to attack. (M.C.G.)

20552 CEND-78

Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.

METALLURGICAL INVESTIGATION OF THE STRESS CORROSION FAILURE IN THE STAINLESS STEEL CLAD OF THE SIC REACTOR VESSEL. George Zuromsky. [nd]. 21p. OTS.

An investigation of the extent and nature of the stress corrosion failure in the stainless steel cladding of the SIC reactor vessel is described. The stress corrosion failure is attributed to the combined residual tensile stresses in the stainless steel clad resulting from omega seal welding and corrosive chemicals from decomposition of the Viton O ring. (J.R.D.)

20553 GAT-296

Goodyear Atomic Corp., Portsmouth, Ohio.

CORROSION CONTROL OF COPPER AND STEEL BY VACUUM DEAERATION. M. E. Tester. May 18, 1960. 14p. Contract AT(33-2)-1. OTS.

Vacuum deaeration was evaluated as a method of corrosion control for recirculating water systems. Water used for the test was maintained at a pH of 5.7 to 6.3 and a velocity of 1.8 to 2.3 fps. A mild steel sample located in the deaerated water indicated penetrations of 1.40 mils after 99 days in 100°F water and 0.15 mil after 88 days in 90°F water. A mild steel sample in low temperature aerated water failed after 65 days due to complete penetration. Corrosion of copper samples was negligible after 99 days in aerated and deaerated water; however, a copper sample in 90% aerated water indicated 1.2 mils penetration while a sample in deaerated water indicated 0.14 mil penetration. A copper sample in 100°F deaerated water indicated less than 0.05 mil penetration. The results indicate that corrosion of copper and steel in recirculating water systems could be reduced by vacuum deaeration, in conjunction with proper pH control. (auth)

20554 HW-64111

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A VERSATILE AUTOCLAVE FACILITY FOR AQUEOUS CORROSION RESEARCH. V. H. Troutner. Mar. 1, 1960. 24p. Contract AT(45-1)-1350. OTS.

An autoclave facility which contains provisions for rapid heating and cooling, steam operation, direct viewing, and gas collecting and measuring is described. (auth)

20555 LMSD-49735
Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.
STRESS CORROSION CRACKING OF BERYLLIUM. C. M. Packer. May 15, 1959. 23p.

An evaluation of the resistance of beryllium to stress corrosion cracking is presented. In this investigation, stressed specimens of block and sheet beryllium, uncoated and anodically coated, were exposed to a salt spray. Some specimens were also exposed to several aqueous media. During testing, the acidity of these media and the electrode potentials were varied. No stress corrosion cracking occurred after exposure to either the salt spray or to the other aqueous media although some general surface corrosion was observed. (auth)

20556 ORNL-2947(p.60-71)
Oak Ridge National Lab., Tenn.
RADIATION CORROSION. G. H. Jenks, H. C. Savage, et al. p.60-71 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

A rocking-autoclave experiment was performed in which a D_2O solution of uranyl nitrate (0.032 m) with $Cu(NO_3)_2$ and excess DNO_3 was exposed in Zircaloy-2. Low-power, low-temperature exposures of short duration were made in order to obtain pressure data from which G_{D_2} and K_{Cu} (225°C) values could be estimated. Exposure at 280°C to the full reactor power was made in five periods, the total irradiation time being 134 hr. The pressure and temperature were followed closely both during and between irradiation periods. Analyses were made of the irradiated solution, the autoclave rinse, the large amount of precipitate, and the specimen surfaces. K_{Cu} (225°C) was estimated to be 1600 to 1700 liters/mole-hr, about three times as large as out-of-pile values found by others. G_{D_2} was estimated to be 1.3 to 1.4. The various pertinent pressure and analytical data were not completely interconsistent but allow an estimated range of Zircaloy-2 corrosion rates of 6 to 12 mpy during most of the exposure. The corrosion rate appeared to increase during the last 30 hr of exposure, and the final rate was probably 30 mpy or more. From various features of the pressure data, estimates of G_{N_2} of 2×10^{-3} to 2.5×10^{-2} were made, which are 7 to 70 times larger than reported values from fission-fragment irradiations of $Ca(NO_3)_2$ solution. Recombination of nitrogen and oxygen was indicated, the apparent rate corresponding to a vapor-phase recombination with a $G_{NO_3^-}$ value of 1 to 3, which is within the range of values for vapor-phase fixation previously reported. (auth)

20557 ORNL-2947(p.91-109)
Oak Ridge National Lab., Tenn.
SLURRY CORROSION AND BLANKET MATERIALS TESTS. E. L. Compere, H. C. Savage, et al. p.91-109 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

Procedures were developed for evaluating the relative durability of experimental preparations of thoria pellets. Experimental preparations calcined from 1000 to 1750°C were compared in accelerated (1- to 2-hr) tests at room temperature using spouted beds to determine general particle integrity and attrition rates. Static autoclave tests and 300-hr exposures of packed pellet beds in flowing D_2O at 260°C in 100A pump loops were made to evaluate high-temperature durability and potential leach-out of additives from the pellets. In-pile Zircaloy-2 autoclave slurry corrosion experiment L5Z-152S was operated satisfactorily at 280°C under oxygen atmosphere at a fission power density of 20 w/ml for a short period, with satisfactory recombination catalysis and no pronounced corrosion effects. Zircaloy-2 specimens from various in-pile autoclave experiments were examined. A pickup of 20 to 110 ppm hydrogen was noted, but appeared to be associated with water corrosion rather than with atmosphere or irradiation effects. A new coiled-pipe core was installed in the 5 gpm in-pile slurry loop which minimized plug-inducing geometries as well as permitting a satisfactory disposition of corrosion specimens. Satisfactory operation of the prototype loop for more than 1500 hr with a slurry of the thoria–½% enriched urania proposed for in-pile use indicated that the present loop design is satisfactory for in-pile operation. (auth)

20558 CEA-tr-X-190
ETUDE DES ALLIAGES AU PHOSPHORE–ZIRCONIUM RÉSISTANT À L'OXYDATION. (Study of Phosphorus–Zirconium Alloys Resistant to Oxidation). Jin-ichi Takamura and Yasuo Sasaki. Translated into French from Nippon Kinzoku Gakkaishi 22, 663-8(1958). 24p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 17038.

20559
ELECTROCHEMICAL STUDY OF PIT CORROSION OF STAINLESS STEEL IN ACID MEDIA. Suzanne Menascé and Jean Montuelle (Centre National de la Recherche Scientifique, Paris). Compt. rend. 251, 235-6(1960) July 11. (In French)

The corrosion phenomena appearing during the evolution of the electrochemical potential of stainless steel in hydrochloric acid alone and with the addition of small quantities of hydrogen peroxide were determined. The tests were made on hypertempered samples, electrolytically polished and passive in air. Pit corrosion was observed only in the potential range between 300 and 100 mv. (J.S.R.)

20560
THE HIGH TEMPERATURE OXIDATION OF BERYLLIUM. PART I. IN DRY OXYGEN. D. W. Aylmore, S. J. Gregg, and W. B. Jepson (Univ. of Exeter, Eng.). J. Nuclear Materials 2, 169-75(1960) June. (In English)

The kinetics of the oxidation of French Flake beryllium in dry oxygen were studied for 300 hour periods at temperatures in the range 500° to 700°C using a vacuum microbalance. At temperatures up to and including 650°C, the oxidation is protective and the rate decreases continuously with time, reaching a value of 0.02 to 0.04 $\mu g/cm^2$ h after 300 hours. At 750°C the rate first decreases and then increases with time, indicating a breakaway reaction and subsequent non-protective oxidation. The curves of weight gain against time show small discontinuities which are ascribed to cracking and healing of the oxide film. (auth)

20561
CORROSION OF SINGLE CRYSTALS IN A9 ALUMINUM BY WATER AT HIGH TEMPERATURE. P. Lelong and J. Hérenguel (Centre de Recherches, Antony, France). Mém. sci. rev. mét. 56, 663-74(1959) Dec. (In French)

In order to avoid the secondary phenomena resulting from selective intergranular attack, the corrosion of high-purity aluminum at high temperatures was studied on single crystals. The elementary mechanism of attack follow on in the following manner: formation of a uniform transparent film; appearance of pits in the reticulation network and the formation of an underlying disordered, grey film; and formation of basins with flaking in which the disordered film is not established and the attack progresses rapidly. Flat,

single-crystal specimens undergo the phenomenon of growth like polycrystalline aggregates. The rates of attack and growth depend on the orientation. (auth)

20562

A STUDY OF THE CORROSION OF MANGANESE AND URANIUM. J. S. Llewelyn Leach. Mém. sci. rev. mét. 56, 675-80(1959) Dec. (In French)

The reported differences in the rate of corrosion of manganese can be explained in terms of the composition of the corroding liquid, the allotropic structure and the hydrogen content of the manganese alloy. The chemical and physical similarity between manganese and uranium has led to an interpretation of the phenomenon of breakaway corrosion in uranium and aluminum in terms of the solution of corrosion product hydrogen in the test specimen. (auth)

20563

THE EFFECT OF CARBON AND ITS DISTRIBUTION ON THE CORROSION RESISTANCE OF ZIRCONIUM IN WATER AT 315°C. H. Coriou, J. Gauduchau, L. Grall, and J. Huré. (Centre d'Études Nucléaires, Saclay, France). Mém. sci. rev. mét. 56, 693-703(1959) Dec. (In French)

Zirconium carbide is more reactive in water than zirconium itself and involves an accelerated corrosion rate. Corrosion is therefore correlated with the carbide distribution network in an extruded bar. The metal deformation process is directly demonstrated as well as some characteristics of oxide layers. (auth)

20564

MECHANISM OF OXIDATION OF ZIRCONIUM AT HIGH TEMPERATURES AND THE LAWS GOVERNING IT. G. Sainfort (Université, Poitiers, France). Mém. sci. rev. mét. 56, 704-12(1959) Dec. (In French)

In an initial section a study is presented of the kinetics of oxidation of zirconium at high temperatures. The observed laws of oxidation are of the linear or cubic type in the case of the lowest temperatures. The second part is devoted to the study of the diffusion of oxygen into the body of the metal from the oxide film. Various diffusion mechanisms are proposed in terms of the temperature of oxidation. (auth)

20565

RUSTING OF CUPRO-ALUMINUM ALLOYS WITH IRON CONTENT. Pierre-Julien Le Thomas, Dominique Arnaud, and Andrée Lethuillier (Centre Technique des Industries de la Fonderie, Paris). Mém. sci. rev. mét. 57, 313-23 (1960) Apr. (In French)

The iron-base constituent of cupro-aluminum alloys was investigated with the purpose to determine the capacity of resistance to the rusting of these alloys. The so-called rusting itself is the consequence of the solubility of the iron base component. An assumption is defined regarding the part taken by the nickel, taking in account the possible modifications of the iron-base constituent, in the case of cupro-aluminum alloys with special additions. (auth)

20566

OXIDATION MECHANISM FOR THE AUSTENITIC 18% Cr-8% Ni STEEL AT ELEVATED TEMPERATURES. J. Bénard, J. Hertz, and Y. Jeannin (E.N.S.C.P., Paris) and J. Moreau (Institut de Recherches de la Sidérurgie, Saint-Germain-en-Laye, France). Mém. sci. rev. mét. 57, 389-94(1960) May. (In French)

It was pointed out on several occasions that the oxidation kinetics of steels alloyed with chromium or aluminum show at high temperatures a rapid and transitory acceleration after a certain time of exposure to the air. This phenomenon was analyzed for the austenitic 18% Cr-8% Ni steel by linking the traditional kinetic study, micro-examination, x-ray, and electron diffraction of the oxides formed at different stages of the reaction. (auth)

20567

INVESTIGATION OF THE EFFECT OF CORROSION INHIBITORS ON THE CRACK CORROSION OF STEEL 1X18H9 IN MAGNESIUM CHLORIDE SOLUTION BOILING AT 153°C. S. A. Balezin and N. I. Podobaev. Zhur. Priklad. Khim. 33, 1300-11(1960) June. (In Russian)

The degree to which inhibitors designated PB-5, PB-8, BA-12 (a condensation product of benzylamine and paraffin), and KI prevented crack corrosion of a steel containing 18.44% Cr, 9.91% Ni, 1.39% Mn, 0.56% Si, and 0.08% C in a saturated $MgCl_2$ solution boiling at 153°C was studied on specimens kept under a stress of 30 kg/mm^2. It was found that addition of 0.1 volume % of HCl to the solution increased crack corrosion by a factor of 1.2 and the general corrosion by a factor of 1.5. The primary layer formed on the metal surface which initially localized the attack and protected the surface was slowly dissolved and replaced by a secondary film formed from the hydrolysis products. Addition of PB-5 and of BA-12 together with KI protected the steel against stress corrosion, while PB-8, BA-12, and KI alone slowed the corrosive attack without preventing it completely. Cathodic polarization at a current density of 0.005 $milliamp/cm^2$ resulted in the complete protection against attack by boiling $MgCl_2$ containing 0.164% KI. Anodic polarization on the other hand reduced the protective action. The electrochemical behavior of the stressed specimens was determined. Addition of iron salts negated the beneficial effect of PB-5, but had little influence on the behavior of BA-12. Abstractor's note: Russian steel designation 1Cr18Ni9. However, X and H are not element names but initials only, transliterated Kh and N. (TTT)

20568

THE INFLUENCE OF ANODIC POLARIZATION ON THE INTERGRANULAR CORROSION OF CHROMIUM-NICKEL STAINLESS STEELS. N. D. Tomashov, G. P. Chernova, and O. N. Markova. Zhur. Priklad. Khim. 33, 1324-34 (1960) June. (In Russian)

On the basis of previous findings which established that the corrosion resistance of stainless steels is increased several thousand fold by anodic polarization, a high C (0.15 to 0.25%), Ti-free Cr-Ni steel was used for further study of the effectiveness of anodic polarization against attack by a boiling solution containing 160g $CuSO_4 \cdot 5H_2O$ + 100 ml H_2SO_4 + 1 liter H_2O. Specimens were tempered at 1050°C and annealed at 650°C or tempered only. Potential measurements were used for establishing the passivity regions on the basis of the expression $K_R/K_g > 1$ indicating the intergranular nature of the corrosive attack, where K_R refers to the experimentally determined resistance change and K_g to the resistance change calculated from the weight loss. It was established that from 0 to +0.3 v strong intergranular attack takes place because the grain boundaries are not yet passivated, while at potential values ranging from +0.51 to +0.83 v the intergranular attack is inhibited, as the steel is completely passivated, allowing only a slight general corrosion. The extent of the passive state of the annealed specimens as compared with the tempered ones was found to be considerably restricted. On increasing the aggressive nature of the attacking medium, the passive, corrosion-resistant region of the annealed steel is reduced to a greater extent than that of the tempered one. The same relative behavior exists also in the transpassivation zone. Anodic polarization was

found effective in protecting the steel against attack by 10% nitric acid solutions containing up to 2% NaF. (TTT)

20569

CORROSION OF STEELS UNDER ATMOSPHERIC CONDITIONS. A. A. Babakov and D. G. Tufanov. Zhur. Priklad. Khim. 33, 1334-40(1960) June. (In Russian)

In order to obtain experimental data on the behavior of a large number of steel specimens under atmospheric attack, two corrosion-testing stations were established: one at Moscow, in an industrial surrounding and another at an agricultural location in the Moscow province. It was found that in an industrial atmosphere the composition of the steel influences considerably its corrosion resistance, the low-alloy steels being superior to the carbon steels. The effect of the structure on the corrosion velocity in non-industrial atmosphere was less noticeable. Cr and Cr-Mn steels were subject to pitting corrosion while Cr-Ni stainless steels were found to be very resistant to attack. In the industrial surrounding the C content of the steel appeared to be directly proportional to its resistance. Similar observations were made with Cr and Ni as an alloying addition. On the other hand, steels containing large amounts of Mn were still strongly corroded. In general, low-alloy steels containing small amounts of Cr, Ni, Cu, Al, or Ti had a corrosion rate reduced by about 25 to 50% compared to C steels. The attack is about 2 to 2.5 times faster during the first year of the testing period than during the subsequent 5 years. As a general rule, the corrosion velocity of both low-alloy and carbon steels was about 3 times higher in the industrial atmosphere compared to rural air. It is planned to continue the long-range testing for a period of 7 to 10 years. (TTT)

20570

CORROSION OF IRON IN ACIDS IN THE PRESENCE OF OXIDIZING AGENTS AND OF INHIBITORS. I. P. Anoshchenko (Novocherkask Polytechnical Inst., USSR). Zhur. Priklad. Khim. 33, 1421-2(1960) June. (In Russian)

Under actual field conditions there is a continuous supply of atmospheric O and therefore the depolarization that takes place is of a complex nature, involving both O and H. Bivalent Fe is first oxidized to the ferric form, being then in turn reduced at the cathodic portions of the metal surface, taking the electrons released by the ionization process. The role played by Fe^{3+} was investigated in order to clarify the action of inhibitors such as KBr, urotropine, atabrine, and $SnCl_4$ in corrosion reactions involving sulfuric and hydrochloric acids. The inhibitors were added in concentrations ranging from 0.01 to 3.0 mg mole/1 while ferric oxide, sulfate, or chloride were also introduced into the system at the rate of 3.0 mg mole/1. It was found that the presence of Fe^{2+} reduces the dissolution rate of metallic iron to about 30% of its original value; Fe^{3+} ions not only do not increase the corrosion rate when added at a rate less than 2.0 mg mole/1 but rather decrease it, in the case there is an O deficiency in the system. Part of the Fe^{3+} is adsorbed on the metallic iron surface, the rest acting as a depolarizer, being reduced to the bivalent state by the electrons liberated in the ionization of the metal. The presence of Fe^{3+} reduces both the cathodic and the anodic polarization, shifting the potential slightly toward the negative side. The behavior of the inhibitors was found to be very similar to that observed in the absence of the cationic oxidizer. (TTT)

20571

A NONDESTRUCTIVE TEST FOR INTERGRANULAR CORROSION IN STAINLESS STEEL. R. C. Robinson (E. I. du Pont de Nemours & Co., Aiken, S. C.). pp.112-18 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

An eddy current method is described which was used to detect intergranular corrosion in stainless steel. The tester had a drift of ±2 μa (±2% full scale) for any 8-hr period. A series of tests was conducted at frequent intervals, the results of which were reproducible within the limits of the instrument drift. (B.O.G.)

20572

PHYSICAL METALLURGY OF STRESS CORROSION FRACTURE. Thor N. Rhodin, ed. Metallurgical Society Conferences. Volume 4. New York, Interscience Publishers, 1959. 405p.

The symposium was arranged by the Committee on Corrosion-Resistant Metals of The Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, and held at Pittsburgh in April 1959. The first half of the symposium was concerned mainly with general principles relating the three basic factors of stress, fracture, and chemical reactivity. No effort was made to emphasize the consideration of practical engineering environment or the complicated behavior of new alloys. The second half of the program was addressed directly toward clarification of the mechanisms of stress corrosion cracking in terms of specific environments and materials. The symposium was conducted to provide a forum for discussion among specialists from divergent fields and experiences in the solid state sciences and in the technology of materials. It was not expected that the symposium would evolve a universal corrosion mechanism of a new super material. The general discussion resulted in special emphasis on the following aspects: (1) relationship between stress and chemical reactivity; (2) concept of embrittlement by localized corrosion; (3) interactions between the initiation and propagation stages of cracking and the influence of crystallography; (4) effect of specific alloy compositions and chemical environments on failure mechanisms; and (5) application of dislocation movement to crack growth. (B.O.G.)

Fabrication

20573 BRB-13

Bridgeport Brass Co., Conn.

MONTHLY PROGRESS REPORT FOR JULY 1955. Aug. 8, 1955. Decl. Mar. 30, 1960. 14p. Contract AT(30-1)-1405. OTS.

Examination of extruded thin-walled uranium tubing showed this material to be of good quality, although an adjustment of tool sizes is required to meet the specified dimensions. Hydrogen analyses of hot-rolled uranium tensile bars for the rod drawing program were completed. The results show a substantial increase in hydrogen during beta treatment, and an apparent correlation with tensile properties. The extruded Zircaloy process tubes were examined for geometry and structure. The latter shows insufficient grain refinement due to the low reduction ratio which may give trouble in later processing. Leak tests on brass billet cans in salt at 725°C indicated that cans made by spinning may have defects which allow leakage. Considerable success resulted from the use of a proprietary phosphate coating and lubricant in deep drawing Zircaloy. A new lubricant involving sodium stearate also shows prom-

ise. A method for obtaining self-consistent x-ray intensities in orientation work is described. This method is being evaluated with hot-rolled uranium rod. (auth)

20574 BRB-16

Bridgeport Brass Co., Conn.

EXTRUSION OF URANIUM FOR HANFORD CORED SLUG PROGRAM—II. G. T. Murray and R. M. Treco. Nov. 4, 1955. Decl. Mar. 30, 1960. 47p. Contract AT(30-1)-1405. OTS.

The development of a satisfactory method of extruding heavy-wall uranium tubing for cored slugs is continued. A number of tool changes were investigated in order to note the effects on the extruded tubes. Brass billets were used as a preliminary measure to evaluate the most promising tool changes while conserving uranium. In this case, the brass extrusions proved to be unrepresentative for evaluating uranium. A discussion of the tooling effects is included. (auth)

20575 BRB-17

Bridgeport Brass Co., Conn.

EXTRUSION OF URANIUM FOR HANFORD CORED SLUG PROGRAM—III AND IV. G. T. Murray and R. M. Treco. Dec. 1, 1955. Decl. Mar. 30, 1960. 33p. Contract AT(30-1)-1405. OTS.

The extrusion of U tubes for HAPO hollow slugs is continued. Alloys of Si, Ti, and Cr proved to be too stiff for extrusion under the conditions described. Extrusion of cast-to-shape billets was successful. An increase in tube I. D. from $\frac{1}{4}$ to $\frac{3}{8}$ inch was made without difficulty, although positioning of the stationary mandrel was shown to be critical. Quenching of the extruded sections leads to internal stresses which produce severe warping. Use of a brass follower block for shearing purposes with resultant mixed scrap has proved unnecessary. Cold straightening of the extruded U tubes by stretching was found to present little difficulty. A number of other modifications in procedure are discussed. (auth)

20576 BRB-31

Bridgeport Brass Co., Conn.

MONTHLY PROGRESS REPORT FOR APRIL—MAY 1956. June 29, 1956. Decl. Mar. 30, 1960. 39p. Contract AT(30-1)-1405. OTS.

A difference in the cupping characteristics between two lots of Zircaloy-2 deep drawing strip led to the investigation of strip orientation. A γ-phase extrusion was initiated to investigate the feasibility of producing solid U fuel element for Hanford by extrusion and swaging. Laboratory evaluation was completed on the extrusion of hollow U fuel element and results are presented. The crystal orientation of a hollow slug tube α-extruded at 1175°F with an area reduction of 24 : 1 was investigated. Three Zircaloy-2 billets (Z-C series) of 8 in. O.D. × 20 in. length were successfully extruded as ribbed tube. (For preceding period see BRB-30). (W.L.H.)

20577 HW-53666

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CERAMIC COATINGS ON URANIUM. D. W. Shannon. Jan. 13, 1958. Decl. June 12, 1959. 26p. Contract W-31-109-Eng-52. OTS.

Four-inch U slugs were successfully coated on a laboratory scale with glass formulations. The coatings were hard glazes about one mil thick and were resistant to shock and abrasion. (W.L.H.)

20578 KAPL-1345

Knolls Atomic Power Lab., Schenectady, N. Y.

THE APPLICATION OF COLD-POWDER EXTRUSION AND SINTERING TO THE FABRICATION OF STAINLESS STEEL—UO_2 FUEL ELEMENTS. H. G. Sowman and G. L. Ploetz. June 3, 1955. Decl. Mar. 16, 1960. 16p. Contract W-31-109-Eng-52. OTS.

An alternate method of fabricating a pin-type stainless steel—UO_2 dispersion-type fuel element was attempted. This process involved the cold-extrusion of the stainless steel and UO_2 powders with an organic binder lubricant. After hot-working the sintered core in a stainless steel cladding, the microstructure, density, UO_2 particle shape, bonding, and resistance to helium penetration were found to be excellent. (auth)

20579 NAA-SR-4909

Atomics International. Div. of North American Aviation Inc., Canoga Park, Calif.

IMPROVED WELDING TECHNIQUES FOR SER FUEL ELEMENT ASSEMBLY CLOSURES. S. Elchyshyn. July 30, 1960. 30p. Contract AT-11-1-GEN-8. OTS.

Fusion welding of end caps to 10-mil wall tubing of stainless steels and high-temperature alloys was found to be unreliable, using the conventional split chill block. A floating chill block was developed, and produced consistently sound welds of high quality. The floating chill block is a shaped copper block, contoured to fit a portion of the tube circumference under slight spring pressure, and positioned directly underneath the electrode. This improved chill block was used to weld closures for each fuel element assembly of a SNAP Experimental Reactor core loading. The diffusion rate of hydrogen through the weld joints at 1200°F was shown to be equivalent to that of the base metal. Materials normally considered difficult to weld by ordinary techniques have been welded successfully, using the floating chill block and unique weld joint designs. (auth)

20580 NAA-SR-5346

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

PROCESS DEVELOPMENT OF URANIUM CARBIDE FUEL SLUGS FOR HNPF. D. H. Turner. July 30, 1960. 26p. Contract AT-11-1-GEN-8. OTS.

Skull casting, induction melting and casting, and hot pressing were evaluated for fabrication of Hallam Power Reactor (second core loading) reference UC slugs 0.798 in. diam by 6 in. long. The skull casting process was the most promising of those investigated and was utilized for the production of sufficient slugs for a 12-rod UC element 5.5 ft long. (auth)

20581 NYO-2801

Nuclear Materials and Equipment Corp., Apollo, Penna.

FINAL REPORT [ON COATING FUEL ELEMENTS], NOVEMBER 15, 1958 THROUGH NOVEMBER 14, 1959. Changed from OFFICIAL USE ONLY July 5, 1960. 61p. Contract AT(30-1)-2264. OTS.

Metal coatings approximately two to ten microns in thickness were successfully applied to UO_2 spheres on a laboratory scale by a variety of methods including the reduction of halides for niobium, chromium, molybdenum, and tungsten; chemical immersion plating for nickel and copper; and electro-plating for chromium, nickel, and copper. In addition, copper and nickel were plated on uranium metal by electroplating. Also a small extrusion consisting of chromium coated UO_2 particles dispersed in a Zircaloy-2 matrix was successfully made without stringering or evidence of reaction between the oxide and the matrix. Small plates consisting of niobium coated UO_2 spheres homogeneously distributed in a matrix of pure niobium were also made entirely by the halide reduction process. The integrity of coatings was evaluated by metallographic examina-

tion, oxidation tests, and acid immersion tests. The hardness of coatings and the crushing strength of particles before and after coating were also determined. In addition, the various coatings were analyzed chemically. (auth)

20582 ORO-300

Clevite Corp. Mechanical Research Div., Cleveland. FUEL-BEARING FIBERGLAS IN ALUMINUM BASE FUEL ELEMENTS. Quarterly Report No. 4 for February 1, 1960 to April 30, 1960. R. H. Baskey. June 2, 1960. 26p. Project No. 50224-G. Contract AT(40-1)-2257. OTS.

Depleted uranium-bearing fiberglas was consolidated into compacts by either hot pressing or cold pressing followed by hot pressing. Densities attained by these methods averaged 99% of theoretical density. Fabrication techniques were not successful to date on producing dummy fuel plates to specifications from the uranium-bearing fiberglas. This may be due to the high glass content in this material (i.e., 54.3% by volume glass) as compared to a 40% by volume glass in the fiberglas drawn from plate glass (uranium-free). The fiber orientation had little effect on the tensile properties of fabricated material. The strength retention of fabricated material was less than as-hot pressed material. These characteristics may be due to the fiber fragmentation. As previously reported, as-hot pressed fiberglas-reinforced aluminum had an average tensile strength of 18,450 psi in the temperature range from 250 to 800°F. The tensile strength of the fabricated material decreased at elevated temperatures, but is was far superior to 1100 aluminum (the matrix metal in the composites). The fabricated fiberglas-reinforced aluminum had tensile strengths up to 20,700, 14,600, and 11,850 psi at temperatures of 72, 400, and 600°F, respectively. At the identical temperatures, cold worked 1100 aluminum had tensile strengths of 18,000, 9,500, and 2,500 psi, respectively. (For preceding period see ORO 273.) (auth)

20583 ORO-303

Clevite Corp. Mechanical Research Div., Cleveland. FUEL BEARING FIBERGLAS IN ALUMINUM BASE FUEL ELEMENTS. Monthly Progress Letter No. 12 [for] May 1, 1960 to May 30, 1960. R. H. Baskey. June 13, 1960. 5p. Contract AT(40-1)-2557. OTS.

The factors producing non-uniform deformation of the core and cladding were investigated. Elevated tensile strength properties of fiberglas-reinforced Al were superior to those of 1100 Al; highest strengths were attained from the as-hot pressed specimens. The effect of fragmentation of the fiberglas on the strength retention properties of the fiberglas-Al system was investigated. (For preceding period see ORO-300.) (W.D.M.)

20584 ORO-304

Clevite Corp. Mechanical Research Div., Cleveland. FUEL BEARING FIBERGLAS IN ALUMINUM BASE FUEL ELEMENTS. Monthly Progress Letter No. 13 [for the] Period June 1, 1960 to June 30, 1960. R. H. Baskey. July 7, 1960. 5p. Contract AT(40-1)-2557. OTS.

Fourteen depleted U-bearing fiberglas compacts were vacuum hot pressed and four were cold pressed. Compacts of U-bearing fiberglas which had been rolled at 1000°F to 0.060 in. thickness exhibited severe edge cracking. Core sections of depleted U-bearing fiberglas were open rolled at 1000°F and then clad rolled into dummy fuel plates. The resulting improvements in these fuel plates are discussed. Extrusion tests on fiberglas-reinforced Al through various extrusion dies did not produce satisfactory results. (For preceding period see ORO-303.) (C.J.G.)

20585 SCNC-246

Sylvania-Corning Nuclear Corp., Bayside, N. Y. DEVELOPMENT OF A COMPARTMENTED TYPE FLAT PLATE FUEL ELEMENT. W. G. Lidman, R. L. Harmon, and H. S. Kalish. Apr. 22, 1957. Decl. Mar. 31, 1960. 31p. Project 1825. For Argonne National Lab. Contract AT-30-1-GEN-366. OTS.

A method for fabricating a compartmented type flat plate fuel element is described. The core of the plate was produced from small U plate segments and Al spacers. After processing, each U plate was located within separate and sealed compartments. Advantages to this type of construction are shown in the results of autoclave tests. It was demonstrated that with this element design, the extent of corrosion damage of the core is minimized. (auth)

20586

SINTERING OF HIGH DENSITY URANIUM DIOXIDE BODIES. C. Y. Ang and E. W. Burkhammer (P. R. Mallory & Co., Inc., Indianapolis). J. Nuclear Materials 2, 176-80(1960) June. (In English)

The sintering of high-density UO_2 bodies from as-received Mallinckrodt Chemical Works powders was investigated. Experiments were conducted in an attempt to achieve 94% density. Three types of densification promoters were used. TiO_2 and CaO imported higher compactibility and sinterability to UO_2 than did $CaTiO_3$. Of the three types of binder or lubricant considered, polyvinyl alcohol was selected for use. Compacting pressures between 10 and 60 tsi were used. Dry dissociated ammonia gas was used as the sintering atmosphere. Depending on the degree of compaction, the sintering conditions required to achieve high density involved temperatures of 1500 to 1600°C with heat times of 3 to 6 hours. Results indicated that 94% density could be obtained along with a stoichiometric O/U ratio in the final product. (M.C.G.)

20587

SINTERING OF URANIUM OXIDES. A. Bel, R. Delmas, and B. François (Centre d'Études Nucléaires Saclay, France). J. Nuclear Materials 2, 192-3(1960) June. (In French)

Results of Sintering experiments with UO_2 on Mo supports in Ar and in H_2 are described. The work reveals that the results in H_2 and in Ar are technologically analogous, the essential difference being in the recrystallization kinetics. (T.R.H.)

20588

THE MECHANISM OF THE PLASTIC DEFORMATION IN TENSION AND OF THE ANNEALING OF ALUMINUM SINGLE CRYSTALS STUDIED BY TRANSMISSION USING A TWO-FILM CHAMBER (X CINETOPOGRAPHY). H. J. Latière and R. Michaud (Centre National de la Recherche Scientifique, Marseille). Mém. sci. rev. mét. 57, 161-72 (1960) Mar. (In French)

The two-film chamber method enabled study of the divisions, groupings, and super-groupings of the crystallites. In particular, it was discovered that there is a rotational slip round the tension axis of single crystals, oscillating within a small angle round this axis. (auth)

20589

REMOTE CONTROLLED MILL FOR ROLLING PLUTONIUM ALLOYS. A. I. Nussbaum (Loma Machine Mfg. Co., Inc., New York). Metal Progr. 78, No. 2, 117(1960) Aug.

A mill for rolling plutonium alloys, designed to operate within an airtight steel vessel, was installed at Hanford, Washington. The hood was designed to be evacuated to a pressure of one micron Hg and then filled with argon to

atmospheric pressure. The main mill motor and auxiliary motors were mounted outside the hood. The machine is a 20 in. wide, two-high/four-high combination rolling mill with rolls that can be changed or replaced by a power operated mechanism. (M.C.G.)

20590

EXTRUSION AND ZONE-MELTING, TWO PROCESSES FOR FABRICATION OF FUEL ELEMENTS IN PRESSURE-TUBE FORM. E. Bodmer (Gebr. Sulzer A. G., Winterthur, Switzerland). Neue Technik 1, No. 5, 3-14(1959) Sept. (In German)

A tubular fuel element for a heavy water moderated reactor with pressurized water cooling is described. The principal methods of fabrication leading to a metallic bond between fuel and cladding are discussed. This metallic bond is possible because the uranium–zirconium system has interesting properties under reactor conditions and does not form any trouble-some intermediate phases. Zone-melted and co-extruded elements have given roughly equal results in various out-of-pile tests. In-pile tests so far show a too low burn-up. (auth)

20591

FABRICATION OF PRESSURE VESSELS FOR REACTORS. K. Menke (Mannesmann A. G., Duisburg-Huckingen, Ger.). Neue Technik 2, No. 2, 55-62(1960) Feb. (In German)

The problems of fabrication of pressure vessels for nuclear reactors are dealt with. The welding problems are treated with particular attention. A view on the experience in this field by Mannesmann in Germany is given. (auth)

20592

A NEW ELECTRON-BEAM WELDING UNIT. W. J. Greene, R. R. Banks, and R. M. Niedzielski (Air Reduction Co., Inc., Murray Hill, N. J.). Welding J. (N.Y.) 39, 791-6 (1960) Aug.

A 15-kv electron-beam welding unit was designed and constructed, using a 7.5-kw laboratory model as prototype. The elements of electron-beam welding units are described. A double magnetic lens system for focusing the beam has the advantages of focusing without mechanical motion and of eliminating the problem of gas breakdown in the following way: A small orifice at the crossover point between the two focusing coils allows the beam to pass but stops the flow of gases from the welding chamber into the electron gun proper. The problem of maintaining perfect focus introduced by this orifice was solved by automatic means using the current flow to the orifice plate as a sensing signal. The defocusing effect of space charge in the beam (repulsion of electrons) was compensated by spreading it to a diameter of ~ 5 cm and then focusing, thereby increasing the radial inward velocity of the electrons. The pumping aspect of the welding unit was provided for with a diffusion pump and an oil booster pump, the latter taking care of gas bursts of high pressure; pressures of 0.1μ could be maintained during welding. Some of the welding characteristics, e.g., effects of beam current on beam penetration in stainless steel and advantages of electron-beam welding are given. (D.L.C.)

20593

PREPARATION OF HAFNIUM CARBIDE. G. A. Meerson and O. E. Krein. Zhur. Neorg. Khim. 5, 1164-7(1960) May. (In Russian)

The charge material consisting of >99% HfO_2 and lamp black was mixed in a rotating vessel for two hours, sieved through a 100 mesh screen, and briquetted into cylinders at a pressure of 2 tons/cm^2 after mixing for another hour. The first series of experiments were carried out with a charge having a stoichiometric composition corresponding to the reaction: $HfO_2 + 3\ C = HfC + 2\ CO$. The charge was fired at a temperature of 2000 to 2200°C and a pressure of 0.2 to 5 mm Hg with a holding time of 1 to 3 hours. The product did not contain any oxygen, but there was a slight deficit in bound carbon (6.0% instead of the theoretical 6.3%). The optimum conditions are addition of 0.4% excess of carbon, a firing temperature of 2200°C, a holding time of one hour, and a pressure of 5 mm Hg. Slightly higher pressures of CO may favor formation of the carbide. Samples of HfC containing 5.99, 6.09, and 6.27% bound carbon were subjected to x-ray analysis. These products were body centered with lattice constants of 4.61, 4.62, and 4.63 A respectively (compared to 4.64 A for HfC from the most recent literature). (TTT)

20594

TWO APPLICATIONS OF EDDY CURRENT INSTRUMENTS TO TESTING OF ZIRCALOY CORE COMPONENTS. R. A. Betz (Westinghouse Electric Corp., Pittsburgh). p.119-26 of "Symposium on Nondestructive Tests in the Field of Nuclear Energy. Presented in Chicago, Ill., April 16-18, 1957. ASTM Special Technical Publication No. 223." Philadelphia, American Society for Testing Materials, 1958.

Two applications are described of commercial eddy current instruments to PWR tubing and weld inspection. Some of the problems encountered are pointed out. No significant data from runs on actual subassemblies are yet available. (B.O.G.)

20595

THE SKULL CASTING OF REFRACTORY METALS. D. R. Carnahan and L. M. Bianchi (Westinghouse Electric Corp., Blairsville, Penna.). p.58-64 of "Transactions of the Vacuum Metallurgy Conference, 1959." Rointan F. Bunshah, ed. New York, New York University Press, 1960.

Vacuum skull casting of refractory materials was investigated because of its potential for making large, uncontaminated castings. Because of the limited surface contamination on zirconium castings from graphite molds, samples of the refractory metals were cast into graphite molds using the bottom pour, nonconsumable melting technique. Skull castings were also produced using consumable techniques. Surface contamination by the molds on small castings was not serious and could be eliminated by surface machining. A larger molybdenum casting showed only slight surface contamination, was sound except for gas holes, and had a fine, uniform grain structure. (M.C.G.)

20596

ELECTRON-BEAM WELDING. M. H. Hablanian (NRC Equipment Corp., Newton Highlands, Mass.). p.130-4 of "Transactions of the Vacuum Metallurgy Conference, 1959." Rointan F. Bunshah, ed. New York, New York University Press, 1960.

An industrial electron-beam welder was designed to bridge the gap between a relatively simple, lower voltage, inexpensive type and a complex, highly efficient, high voltage type. The welding apparatus consisted of a high-vacuum chamber 2 ft in diameter. The electron gun assembly was externally mounted on one of the chamber ports. Maximum voltage used was between 10 and 20 kv and the maximum beam currents were from 100 to 200 ma. The electron gun incorporated an electromagnetic focusing system which provided easy focusing for various beam voltages. In addition to the welder design, the report also included a brief review of the history of electron beam welding and descriptions of the other two types of welders. (M.C.G.)

20597

DESIGN OF ELECTRON-BEAM WELDERS FOR PRODUCTION SERVICE. Theodore H. Crane (High Vacuum Equipment Corp., Hingham, Mass.). p.135-9 of "Transactions of the Vacuum Metallurgy Conference, 1959." Rointan F. Bunshah, ed. New York, New York University Press, 1960.

In designing commercial electron-beam welders, in addition to considerations of the materials and part configurations to be welded, there are also problems of maintaining vacuum. In a design for welding circular seams, a work-accelerated gun was supported on a backlash-free rotary sliding seal. The mount gave 4-in. vertical travel and about 180° rotation of the gun-mount arm from outside the chamber. The work was held in a motor-driven chuck for rotation. The first practical welding gun was of the work-accelerated-type emission system. It had good power capability, but the large equipotential surface of the face of the gun had a strong defocusing effect. Subsequent designs brought improvements in focusing and the development of a self-accelerated emission system type. (M.C.G.)

20598

CASTING METALS. Albert Ronald Clifton Westwood (to Imperial Chemical Industries Ltd.). British Patent 834,627. May 11, 1960.

A method for casting a metal in a mold is presented. The method consists of supporting a block of the metal to be cast above the mold and arc-melting the block. (W.L.H.)

20599

IMPROVEMENTS IN OR RELATING TO PROCESSES FOR THE PRODUCTION OF CERAMIC BODIES. David Thomas Livey, Peter Murray, Reginald Scott, and Jack Williams (to United Kingdom Atomic Energy Authority). British Patent 837,023. June 9, 1960.

A process is reported for the production of ceramic bodies of refractory metal oxides by pressing at a moderate temperature. The refractory metal powder is pressed at a temperature of 600 to 1000°C and a pressure of 5 to 10 tsi. (W.L.H.)

20600

IMPROVEMENTS IN OR RELATING TO PIPE JOINTS. Ronald Scott Challender and Richard Phillip Kinsey (to United Kingdom Atomic Energy Authority). British Patent 837,920. June 15, 1960.

A method was devised for making and breaking T joint welds between two pipes in inaccessible places and consists of cutting two opposed holes through the walls of the first pipe, joining the second pipe to one of the holes, and closing the other hole with an externally welded closure cap. This method was used for the attachment of pipes to a reactor for coolant flow. (D.L.C.)

20601

IMPROVEMENTS IN OR RELATING TO JOINTS BETWEEN TUBES OF DISSIMILAR MATERIALS. Sydney Fawcett and William Rodwell (to United Kingdom Atomic Energy Authority). British Patent 839,782. June 29, 1960.

A method was invented for joining tubes of different materials and sizes by inserting the smaller tube through the larger tube and effecting a seal. This arrangement is necessary in a sodium-cooled graphite-moderated reactor, and the method of joining was devised for this purpose. The effect of thermal cycling on the seal is offset by sealing flanges (internal flange on larger tube and external flange on smaller tube) having thermal expansion coefficients intermediate between those of the tubes, using sealing means with such an expansion coefficient as to stabilize the load variation in the sealing ring. An example is given in which a zirconium tube is joined to a mild steel tube with a nickel alloy sealing ring. (D.L.C.)

20602

IMPROVEMENTS IN OR RELATING TO THE COATING OF TANTALUM. (to United States Atomic Energy Commission). British Patent 840,203. July 6, 1960.

A method is described for protecting Ta metal against attack by molten U. The method consists of contacting Ta with elemental B in a vacuum at 1800°C until a layer of B is formed on the surface of the Ta. The boride-coated Ta element is removed from contact with the B and placed in a vacuum at 1800°C where the boride is converted to the tantalum monoboride. (W.L.H.)

20603

PLATED CANS FOR FUEL ELEMENTS. (to Deutsche Gold-und Silber-Scheideanstalt Vormals Roessler). British Patent 840,609. July 6, 1960.

The preparation of steel-plated Zr cans for fuel elements which are exposed to a surface temperature of more than 300°C is reported. A Zr tube is coated with 30 to 300 μ thick steel by being forced or shrunk or by welding. (W.L.H.)

Properties and Structure

20604 57-RL-1847

General Electric Co. Research Lab., Schenectady, N. Y.

A COMPILATION AND INTERPRETATION OF CYCLIC-STRAIN FATIGUE TESTS ON METALS. J. F. Tavernelli and L. F. Coffin, Jr. Nov. 1957. 25p.

Previously reported cyclic-strain fatigue data are compiled and interpreted in terms of plastic-strain. The relationship $N^{0.5}\Delta\epsilon_p = c$ best fits all the data regardless of the metals tested, the temperature of testing, and the manner of testing. The significance of the fracture ductility to low-cycle fatigue is discussed. Good agreement was found when the fracture strain value was placed on the fatigue curve at N = 0.25. (auth)

20605 60-GC-80

General Electric Co. Research Lab., Schenectady, N. Y.

EFFECT OF BASIC PHYSICAL PARAMETERS ON ENGINEERING PROPERTIES OF INTERMETALLIC COMPOUNDS. First Annual Report [for] December 15, 1958–December 15, 1959. D. L. Wood and J. H. Westbrook. Jan. 1960. 31p. Project No. 9(8-8350). Contract AF33(616)-6144.

To facilitate subsequent studies of the nature of the brittleness in intermetallic compounds, a method for producing sound, uniform, and reproducible test specimens was devised and an investigation made of the effects of basic physical parameters on the mechanical properties. Tensile test specimens of Bi_2Tl and AgMg, produced directly by extrusion, provided information applicable to future studies of the properties of NiAl, a material whose melting point and oxidation resistance render it not impractical as an alloy base should a solution to the ductility problem be found. A pronounced yield point is found in AgMg; high strain rate sensitivity of the yield stress was observed and the effects of grain size, composition, and test temperature were documented. Specimens will withstand loading only at very slow strain rates; after yielding occurs, rapid strain rates may be employed. With total elongations of more than ~50%, the material is ductile under previously brittle conditions. Measurement of the

yield stress as a function of both strain rate and temperature enables a calculation of the activation energy for the yielding process. (auth)

20606 AD-233531

Aluminum Co. of America. Alco Research Labs., New Kensington, Penna.

STRUCTURAL EFFICIENCY OF MATERIALS AT ELEVATED TEMPERATURES. Report No. 12-57-38A. A. H. Knoll and J. W. Clark. July 30, 1958. 60p.

Methods of measuring the relative structural efficiency of Al alloys and other materials for use at high temperatures are given. A comparison was made among Al, Mo, and Ti alloys and stainless steel relative to fabrication, buckling, efficiency under compressive loading, creep, tensile strength, and thermal stresses as functions of high temperature. Advantages of Al alloys are discussed. (C.J.G.)

20607 AE-30

Aktiebolaget Atomenergi, Stockholm.

METALLOGRAPHIC STUDY OF THE ISOTHERMAL TRANSFORMATION OF BETA PHASE IN ZIRCALOY-2. G. Östberg. Apr. 1960. 45p.

An investigation of the structure of commercial Zircaloy-2 revealed that the high temperature beta phase is transformed isothermally at lower temperatures into alpha plus secondary precipitate. The alpha occurs mainly as Widmanstätten plates developed by a shear mechanism. The secondary precipitate is formed from the beta–alpha structure at the phase boundary between these phases. This precipitation of particles of secondary phase occurs on account of a eutectoid reaction, alpha also being formed. A time-temperature-transformation diagram was constructed from the observations. (auth)

20608 AERE-T/R-315

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

TABLES FOR FINDING THE EFFECT OF IMPURITIES IN URANIUM AND GRAPHITE. C. A. Rennie. [nd]. 4p.

Revision of AERE-T/R-284.

A table is presented for finding the effects of impurities in uranium and graphite. The elements, their cross sections, the ppm necessary to give 0.1% competitive absorption in uranium, the competitive absorption in uranium of 1 ppm of impurity, and the change in carbon cross section in mb for 1 ppm are listed. (M.C.G.)

20609 ANL-6167

Argonne National Lab., Ill.

KINETICS OF DISSOLUTION OF ZIRCONIUM IN MOLTEN URANIUM. Gerald H. Golden. May 1960. 38p. Contract W-31-109-Eng-38. OTS.

The dissolution of Zr in molten U was studied, employing a one-dimensional model that assumes the rate of dissolution to be purely diffusion-controlled. The theoretical study proceeded in three stages: (1) dissolution into a solution of infinite depth was treated, assuming the solid-liquid interface to be stationary; (2) dissolution into a solution of finite depth was studied, keeping the interface stationary (it was found that the second model was approximated closely by the more simple first model); (3) dissolution into a solution of infinite depth was studied, assuming the interface to move with time. It was found that the moving interface model is approximated closely by the simpler stationary interface model at temperatures not greatly in excess of the U melting point. This approximation becomes increasingly erroneous as the solution temperature increases, but at the higher temperatures the dissolution rate may become solute phase-transfer controlled, invalidating the diffusion-controlling assumption. Equations were derived that permit the dissolution rate and total amount of Zr in solution to be determined from a knowledge of the diffusion coefficient and equilibrium solubility data. The derivations are sufficiently general that the equations are applicable to any one-dimensional dissolution system in which the rate of dissolution is diffusion-controlled. (auth)

20610 BMI-1450

Battelle Memorial Inst., Columbus, Ohio.

FACTORS AFFECTING THE DUCTILITY OF IRON–CHROMIUM–ALUMINUM ALLOY SHEET. Roy W. Endebrock, Ellis L. Foster, Jr., and Ronald F. Dickerson. July 7, 1960. 26p. OTS.

An evaluation of induction-melting and fabrication procedures for the Fe-25 wt.% Cr-5 wt.% Al alloy and the use of Y, Nb, and Ti as grain refiners in the alloy was undertaken. Melts were prepared from different grades of Fe and Cr under various conditions of furnace atmospheres, slags, and melt hold times. Cu, N, and probably Si were found to be detrimental to bend ductility. In vacuum-induction melting, a long hold time after all additions were made removed volatile elements, including Cu, and nullified the harmful effects of N, thereby improving bend ductility. It was found that a vacuum-melting procedure involving a long hold time after additions allows the use of ferrochromium as a substitute for high-purity grades of Cr. Nitrogen introduced during melting or welding destroyed the high-temperature oxidation resistance of the alloy. A thermal exposure in air at 2100°F for 100 hr cancelled any beneficial effects in bend ductility derived from a short-time 1500°F anneal. Grain size showed no relationship to bend ductility. Yttrium and combined Nb-C additives to the Fe-Cr-Al alloy reduced both grain size and grain growth, but these additives did not improve ductility. Titanium acted as an embrittling contaminant. (auth)

20611 BMI-X-159

Battelle Memorial Inst., Columbus, Ohio.

STRUCTURAL MATERIALS FOR THERMAL NUCLEAR REACTORS OPERATING AT ABOUT 1950 F WITH AIR AS A COOLANT. Walston Chubb, John A. De Mastry, Seymour G. Epstein, Roy W. Endebrock, Donald P. Moak, and Ronald F. Dickerson. July 20, 1960. 76p. OTS.

Data from a survey of the literature on all refractory metals including stainless steels and nickel-, chromium-, and niobium-base alloys were reviewed and assembled for the purpose of obtaining an estimate of the potential materials for use as cladding materials in a nuclear reactor operating in air at 1950°F. Criteria established for selection of materials include a life of 10,000 hr at a stress of 1000 psi, a loss of material by oxidation of less than 0.010 in., and a macroscopic thermal-neutron-capture cross section of less than about 0.38 cm^{-1}. Some austenitic stainless steels and nickel-base alloys appear to have properties which meet the design criteria. It is recommended that an experimental program be initiated to check the suitability of these or similar materials with respect to these design criteria. It is also recommended that a supporting effort be directed toward developing composites of strong chromium or niobium alloys clad with materials of the ferritic stainless steel type which are oxidation resistant but are unable to support appreciable stress at elevated temperatures. (auth)

20612 DMIC-130

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

SELECTED SHORT-TIME TENSILE AND CREEP DATA

OBTAINED UNDER CONDITIONS OF RAPID HEATING. Donald P. Moon and Ward F. Simmons. June 17, 1960. 90p. Contract AF18(600)-1375. (PB-151088). OTS.

Graphs of short-time elevated-temperature strength data obtained under conditions of rapid heating are presented. Stress-versus-temperature curves of tensile strength, yield strength, and stress to produce 1% creep strain or rupture in designated times are presented for a number of alloys and steels. Data are given for 28 alloys in sheet form, including 3 Al alloys, 6 Ti alloys, 2 alloy steels, 3 tool steels, 6 Cr–Fe–Ni alloys, and 8 superalloys. A bibliography containing 121 references pertaining to test methods and equipment and to very-short-time data for these and many other materials is presented. (auth)

20613 HW-62073

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PRELIMINARY INVESTIGATION OF THE TRANSFORMATION RATES OF PLUTONIUM–URANIUM ALLOYS. R. D. Nelson and J. M. Taylor. Jan. 28, 1960. 19p. Contract AT(45-1)-1350. OTS.

Heating curves and time-temperature-transformation (T-T-T) curves of three plutonium–uranium alloys containing 3, 7, and 15% uranium showed that the low temperature peritectoid reaction occurs at 115 to 118°C. The T-T-T curves were similar to those describing unalloyed plutonium with a maximum rate of transformation temperature of –20°C. The Pu–7% uranium T-T-T curve was shifted significantly to the right of that describing Pu–3% uranium. No transformation upon cooling was observed in the Pu–15% uranium alloy. The extent of beta stabilization was considerably greater for the Pu–U alloys than unalloyed plutonium. The fraction untransformed was 62% at 60°C for the Pu–3% alloy. Voids formed in the shape of microcracks after thermal cycling at –23 to 175°C. (auth)

20614 NAA-SR-4905

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THERMAL CONDUCTIVITY AND THERMAL EXPANSION OF BeO AT ELEVATED TEMPERATURES. R. E. Taylor. July 30, 1960. 19p. Contract AT-11-1-GEN-8. OTS.

The thermal conductivity, k, of BeO was measured from 350 to 2000°C as a function of density and composition by using a steady state radial heat flow method. Pure BeO specimens of 91 to 95% density exhibited thermal resistivities of $1/k = (1.991 \times 10^{-2}\ T - 9.21)$ cm-sec-deg/cal from 650 to 1680°K. Hot-pressed BeO of 99% theoretical density exhibited thermal resistivities of $1/k = (1.906 \times 10^{-2}\ T - 9.56)$ cm-sec-deg/cal from 900 to 1850°K. A marked increase in "k" occurred above 2100°K and a $\ln(\Delta k)$ against 1/T plot yields an activation energy of 3.2 ev. The addition of 1% MgO to the hot-pressed specimens lowered the thermal conductivity minimum to about 1950°K and yielded an activation energy of 2.2 ev. Thermal expansion measurements were made from room temperature to 1100°F on BeO samples using a dilatometer. No appreciable change was caused by varying the density from 50 to 95%, by using BeO powder from different sources, or by varying the hot-press procedures. The measured expansions indicated a percentage coefficient of linear expansion varying between 8.61 and 9.02×10^{-6}/°C and agreed with high temperature x-ray lattice parameter measurements and with previous linear expansion measurements. (auth)

20615 NAA-SR-5310

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THE CADMIUM–CADMIUM HALIDE SYSTEMS. L. E. Topol and A. L. Landis. July 15, 1960. 15p. Contract AT-11-1-GEN-8. OTS.

The solubility of Cd in $CdCl_2$, $CdBr_2$, and CdI_2 up to 1000°C was determined by thermal analysis and decantation techniques. The monotectics for the systems were found to be 13.7 mole % Cd at 537°C in $CdCl_2$, 14.1% at 536°C in $CdBr_2$, and 2.5% at 383°C in CdI_2. The solubility of the metal was greatest in the bromide, slightly less in the chloride, and least in the iodide. The solubilities of the salts in the metal were found to be about 0.05 mole % at 320°C. Cryoscopic analyses of the salt-rich liquidus curves yielded a cryoscopic number of one and suggested the species, Cd_4X_8 or Cd_3X_4, in the solvents $CdCl_2$ and $CdBr_2$. (auth)

20616 NP-8879

Stockholm. Univ.

STUDIES ON THE CRYSTAL CHEMISTRY OF TITANIUM, VANADIUM AND MOLYBDENUM OXIDES AND OF ALKALI WOLFRAM BRONZES AT ELEVATED TEMPERATURES. Period covered: February 15–May 14, 1960. Arne Magnéli. May 26, 1960. 4p. Contract DA-91-591-EUC-1319. (QTSR-2).

Investigations reported include those on titanium oxides, vanadium oxides, mixed titanium–vanadium oxides, molybdenum oxides, and tungsten bronzes. (J.R.D.)

20617 ORNL-2947(p.121-3)

Oak Ridge National Lab., Tenn.

METALLURGY. A. Taboada, et al. p.121-3 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

Resistance measurements were made on Zircaloy-2 as a function of temperature from 100 to 1050°C, at heating and cooling rates from 2 to 70°C per minute. The alpha/alpha-plus-beta temperature is shifted slightly upward to above 827°C at the highest heating rates; on cooling, it is depressed to 785°C for rates of 2 and 5°C per minute, 781°C for 10°C per minute, and 760°C for 70°C per minute. Two "bumps" appear in the resistance-temperature curve that cannot be explained through the present knowledge of the physical metallurgy of Zircaloy-2. One, about 2% in magnitude, occurs between 250 and 450°C, and the second occurs in the alpha-plus-beta two-phase field. Both are affected by heating and cooling rate and, to some extent, by prior thermal history. Hydrogen content is not the cause. Transformation kinetics studies were started on the Zr-15Nb-1Cu ternary alloy and the Zr-Cu and Zr-Mo binary alloys. Both isothermal and beta-quench and reheat transformations are being studied. The ternary alloy behaves similarly to the parent binary alloy except that, in the beta-quench and reheat transformation, greater amounts of omega phase seem to be formed during the heating to aging temperature. The isothermal transformation product is nodular and grows grain by grain. Metallographic etchants were developed for the revelation of the microstructures of the isothermally transformed Zr-Cu specimens but not for the Zr-Mo specimens. The isothermal transformation product for the Zr-Cu system is nodular and grows from the grain boundary into the grain. Twenty-four sets of pellets were fabricated with varying compositions and fabrication techniques for abrasion testing to determine optimum manufacturing combinations. Techniques adequate for making flat-ended, cylindrical pellets were found to result in pressure laminations when used in making spherical-ended pellets. The underwater constricted-arc cutting process utilizing special torches was applied successfully in cutting the diffuser screens into strips for removal from the HRT core vessel. (auth)

20618 SEP-72
Sylvania Electric Products Inc., Bayside, N. Y.
THE CONTROL OF GRAIN SIZE IN SINTERED URANIUM COMPACTS. John L. Zambrow and Henry H. Hausner. Aug. 30, 1951. Decl. Feb. 16, 1960. 24p. Contract AT-30-1-GEN-366. OTS.

Various powder metallurgical methods for manufacturing sintered U were investigated for their effects on grain size and especially on production of solid U with randomly oriented grains of optimum size. Results of the investigation showed that, with a proper choice of procedure, the grain size of sintered U compacts could be varied over a wide range. The methods and resultant grain size are summarized. (M.C.G.)

20619 SEP-95
Sylvania Electric Products Inc., Bayside, N. Y.
PHYSICAL PROPERTIES OF URANIUM SLUGS MADE BY POWDER METALLURGY. J. L. Zambrow and H. H. Hausner. July 1952. Decl. Feb. 16, 1960. 20p. Contract AT-30-1-GEN-366. OTS.

The process of manufacturing solid U by powder metallurgical hot-pressing techniques is briefly discussed. The properties of U slugs and rods studied were purity, density, hardness, mechanical properties, grain size, grain orientation, grain growth, dimensional stability, and thermal conductivity. (M.C.G.)

20620 SEP-102
Sylvania Electric Products Inc. [Atomic Energy Div.], Bayside, N. Y.
URANIUM–ALUMINUM DIFFUSION AND ASSOCIATED STUDIES. Samuel Storchheim and John Zambrow. Oct. 30, 1952. Decl. Feb. 16, 1960. 29p. Contract AT-30-1-GEN-366. OTS.

During an investigation of the alloying of U and Al, the rate of diffusion of Al into U was compared to that of U into Al. The effect of pressure increase between U and Al during interaction on the rate of penetration of UAl_3 into Al was studied. Linear increase of Al_2O_3 films placed between U and Al in reaction couples inhibited U-Al reaction. Al-Si eutectic penetration into Al was found to be less than for UAl_3 penetration into Al. (L.T.W.)

20621 USNRDL-TR-419
Naval Radiological Defense Lab., San Francisco.
MEASUREMENTS OF THE THERMAL PROPERTIES OF METALS AT ELEVATED TEMPERATURES. R. L. Rudkin, W. J. Parker, and R. W. Westover. May 11, 1960. 32p.

The thermal properties of tungsten were measured at 1500 to 2900°K using a resistance-heated 10 mil wire suspended in a vacuum of 10^{-5} mm Hg. The temperature distribution along the wire was obtained with a two color photoelectric pyrometer utilizing a photomultiplier tube and two optical interference filters isolating two narrow wavelength bands in the visible region of the spectrum. The total hemispherical emittance varied from 0.27 at 1500°K to 0.36 at 2900°K while the range of heat capacity was from 0.030 cal/gm°K to 0.048 cal/gm°K in the same temperature interval. The thermal conductivity was linear over this temperature range, changing from 0.20 to 0.17 cal/cm sec°K. The product of the thermal conductivity and the electrical resistivity divided by the absolute temperature was nearly constant and was about 10% lower than the theoretical value of the Lorentz number. (auth)

20622 WADD-TR-60-108
Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF SINTERABLE POWDERS AND PROPERTIES OF BERYLLIA CERAMICS. Period covered: February 15, 1959 through December 31, 1959. James E. Johnson, A. K. Smalley, and Winston H. Duckworth. Mar. 1960. 23p. Project No. 7371. Contract AF33(616)-6238. OTS.

Information was developed on the effects of processing variables and microstructure on the fracture strength of ceramics made from sinterable oxide powders. The characteristic of high strength associated with low porosities and small average crystal sizes was observed in ceramics of both MgO and BeO, but no quantitative correlation was found. Highest strengths were obtained when time and temperature of sintering were sufficient for densification above about 96% theoretical, provided that the sintering time and temperature was insufficient to give crystal sizes larger than the smallest observed, 5 to 6 microns for BeO ceramics and 10 microns for MgO ceramics. In the case of BeO powder prepared by pyrolysis of high-purity sulfate, calcining to an intermediate temperature (1700 to 1800°F) gave powder that densified most readily when compacted and sintered, but one that did not have the greatest tendency toward crystal growth. The lack of quantitative correlations between bulk density, average crystal size, and strength, indicated that strength was affected by some factor or factors other than these two. (auth)

20623 AEC-tr-4135
CARBON CHARACTERISTICS AT ELEVATED TEMPERATURE. Sanchi Midzushima. Translated for Los Alamos Scientific Lab. from Tanso (Carbons) 7, No. 3, 70-3(1959). 10p. JCL.

The mechanical strength and electrical resistance of carbon were measured at 0 to 4000 and 0 to 2500°C, respectively. The relationship between vapor pressure and heat of sublimation was analyzed for carbon. (C.J.G.)

20624 JPRS-2950
PRODUCTION AND PHYSICAL METALLURGY OF PURE METALS. PART II. AN IMPROVED METHOD OF PREPARING IODIDE CHROMIUM AND ITS PROPERTIES. V. S. Emel'yanov (Yemel'yanov), A. I. Evstyukhin (Yevstyukhin), D. D. Abanin, and V. I. Statsenko. Translated from Met. i Metalloved. Chistykh Metallov No. 1, 44-62(1959). 24p. OTS.

A laboratory installation for refining chromium is described. The installation is able to prepare crystalline rods of iodide chromium weighing 100 to 140 g in 15 to 20 hr. The refining method can be applied to semi-industrial production. Optimum refining conditions are described, and properties of the refined product are examined. (J.R.D.)

20625 JPRS-2953
THE EFFECT OF TERNARY INTERMETALLIC COMPOUNDS ON THE HEAT RESISTANCE OF DEFORMED ALUMINUM ALLOYS. B. K. Vul'f and M. N. Chernov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Tsvetnaya Met., No. 2, 147-52(1960). 11p. OTS.

The microhardness of ternary intermetallic alloys of Al with Cu, Mn, Ni, Mg, Zn, Cr, Si, and Fe was measured at 20 and 300°C. The effects of addition of these elements on the short- and long-term heat resistance of extruded Al alloys were investigated. The solubilities of ternary intermetallic Al alloys in solid Al were measured. (C.J.G.)

20626 UCRL-trans-505(L)
CONCERNING THE CRYSTALLIZATION OF THIN ANTIMONY FILMS. W. Lotmar. Translated by Esther Fultz (Univ. of Calif., Radiation Lab.) from Helv. Phys. Acta 18, 369-88(1945). 29p. JCL.

The antimony films were studied by electron microscopy, optical methods, and by electron diffraction. It was found

that films evaporated in vacuum are first amorphous, then crystallize spontaneously. The number of crystals can be greatly increased by outside stimulation. Crystal nuclei growth speed depends on film thickness. Other observations on the structure of these films are included. (J.R.D.)

20627

AN X-RAY STRUCTURE INVESTIGATION OF THE LIQUIDS OF SODIUM, POTASSIUM AND SODIUM–POTASSIUM ALLOYS. B. R. Orton, G. I. Williams, and B. A. Shaw (Fulmer Research Inst., Ltd., Stoke Poges, Bucks., Eng.) Acta Met. 8, 177-86(1960) Mar. (In English)

The x-ray structures of liquid sodium, potassium, and sodium-potassium alloys were investigated by an improved method. By using a reservoir technique, a plane horizontal surface of liquid metal was examined by a monochromatic x-ray beam in a focusing Geiger diffractometer. Thus the absorption correction, which was one of the greatest sources of error in previous work, was constant and omitted from the analysis. The radial distribution method of analysis was used to interpret the results. None of the liquids examined showed evidence of structure other than that associated with a statistical mixture of atoms. In particular the position of the intensity peak was found to depend in a fairly simple way on alloy composition and did not show the marked deviation at compound composition Na_2K as reported by other workers. The use of the radial distribution method was examined critically. It is felt that the method is adequate for interpreting simple liquid structures provided suitable modification functions are used to expose spurious detail. (auth)

20628

SOLID STATE EQUILIBRIUM IN THE URANIUM–ALUMINUM–CARBON SYSTEM. Vittorio Cirilli and Cesare Brisi. Atti accad. sci. Torino. Classe sci. fis., mat. e nat. 94: 424-31(1959–1960). (In Italian)

The solid-state equilibrium relationships between the phases present next to the united aluminum uranium monocarbide were studied. In this part of the system, two ternary carbides were identified by x-ray methods. The formulas correspond approximately to UAl_5C_4 and $U_2Al_3C_3$. The metallic aluminum and the uranium monocarbide can not coexist in equilibrium conditions. The solid-state reactions below 600°C are extremely slow and even at higher temperatures practically stop once the metallic aluminum disappears. (tr-auth)

20629

EFFECT OF THE PURITY OF THE ALUMINUM ON THE EVOLUTION OF THE POLYGONIZATION SUBSTRUCTURE DURING REPEATED THERMAL TREATMENTS. Pierre Lesbats and Jean Montuelle (Centre National de la Recherche Scientifique, Vitry, France). Compt. rend. 250, 4154-6(1960) June 20. (In French)

The behavior of the polygonized structure on aluminum monocrystals submitted to repeated slight cold working followed by anneal at high temperature is studied. In the first thermal cycles the striation caused by polygonization is simplified, and then a very rapid evolution of polygonization is produced. It is seen that whatever the number of thermal cycles the length of the initial diffraction spot does not vary. The evolution of polygonization seems to be faster the higher the degree of purity of the aluminum. It is shown that repeated thermal treatments on aluminum monocrystals permits the reorganization of the polygonization walls and the perfecting of the sub-blocks. The distribution of the substructure, however, does not improve. The migration of the walls is strongly increased by the decrease of impurity concentrations. (J.S.R.)

20630

STUDY OF THE γ-β AND γ-α TRANSFORMATIONS OF THE BINARY ALLOYS URANIUM–CHROMIUM, URANIUM–IRON, AND URANIUM–MOLYBDENUM, WITH LOW CONCENTRATIONS OF CHROMIUM, IRON, OR MOLYBDENUM, DURING THEIR RAPID COOLING. Jean Delaplace and Roland Bigot (École Nationale Supérieure de la Métallurgie et de l'Industrie des Mines, Nancy and Commissariat à l'Énergie Atomique, Saclay, France). Compt. rend 250, 4157-9(1960) June 20. (In French)

The rapidity of cooling has a negligible influence on the temperature for the beginning of the γ-β transformation of U–Cr and U–Fe and of the β-α transformation of U–Fe. On the contrary, it has an important effect on the γ-β transformation of U–Mo with 2.8 at.% Mo and especially on the β-α transformation of the U–Cr alloys. These observations are valid for rapidity of cooling less than 5000°C/min. (tr-auth)

20631

CONTRIBUTION TO THE STUDY OF THE HAFNIUM–HYDROGEN SYSTEM. Lucien Espagno, Pierre Azou, and Paul Bastien (Centre de Recherches de Physique à l'Ecole Centrale des Arts et Manufactures, [France]). Compt. rend. 250, 4352-4(1960) June 27. (In French)

The behaviors of hafnium and zirconium were compared with respect to hydrogen by means of dilatometric and radiocrystallographic techniques. The solubility of the gas in the two metals was also determined. (tr-auth)

20632

DIRECT OBSERVATION OF THE CRYSTALLINE UNITS CONSTITUTING THE SLIP BANDS IN VERY PURE ALUMINUM. Henri-Jean Latière and Roger Michaud. Compt. rend. 250, 4386-8(1960) June 27. (In French)

The subdivision of slip lines in discrete regions was shown by examination of aluminum crystals in polarized light. Examples of the slip lines after plastic extension are shown. Microscopic examination confirms the existence of microcrystallites produced by the plastic deformation of a large crystal. The microcrystallites have dimensions less than a micron. (J.S.R.)

20633

THE OXIDATION AND CARBURIZATION OF THIN LAYERS OF BERYLLIUM. Jean-Jacques Trillat, Léa Tertian, and Monique Bonnet-Gros (Centre National de la Recherche Scientifique, Bellevue, France). Compt. rend. 251, 10-13 (1960) July 4. (In French)

Electron diffraction permits the oxidation, under very low pressure, of thin beryllium films prepared by thermal evaporation to be followed in detail. Carburization of beryllium obtained by reciprocal diffusion of the carbon and beryllium can also be observed. The conditions under which the oxide BeO appears during heating in a vacuum or during ionic bombardment are first defined. Then the case of carburization is studied. (J.S.R.)

20634

EFFECT OF SMALL QUANTITIES OF IMPURITIES ON THE PHENOMENA PRECEDING RECRYSTALLIZATION OF COLD-WORKED ALUMINUM. Christian Messager and Omourtague Dimitrov. Compt. rend. 251, 88-90(1960) July 4. (In French)

In the cold-worked state aluminum is constituted by small blocks with relatively imperfect structure. During anneal these blocks are perfected, and the beginning of recrystallization is formed by the increased growth of some of these blocks. For a series of Al samples of different purities the anneal temperature necessary for the appearance of these structures was determined. It was

shown that the development of new crystals occurs in a cold-worked matrix in aluminum prepared by zone melting, whereas it is produced in a restored matrix in less pure aluminum. This difference is explained by the fact that the effect of impurities is greater on the growth of the blocks formed during cold-working than on their perfecting. (J.S.R.)

20635

EQUILIBRIUM DIAGRAM FOR Ni–NiAl–Mo ALLOYS. Yu. A. Bagaryatskiĭ and L. E. Ivanovskaya (Inst. of Metal Studies and Metal Physics, Central Research Inst. of Ferrous Metallurgy, USSR). Doklady Akad. Nauk S.S.S.R. 132, 339-42(1960) May 11. (In Russian)

Microstructure and x-ray-diffraction methods were used in phase studies of Ni–NiAl–Mo alloys annealed at 1200°C for 100 hours; 1200°C for 100 hours + 1000°C for 100 hours; and 1200°C for 100 hours + 1000°C for 100 hours + 800°C for 100 hours. The results are tabulated, and an isothermal cross section of the constitution diagram for Ni–Al–Mo alloy at 1200°C was plotted. It is shown that the isothermal cross section of Ni–NiAl–Mo alloy at 1200°C is identical to the isothermal cross sections of Ni–NiAl–Cr at temperatures below 100°C; at lower temperature the Ni–NiAl–Mo alloys have equilibrium γ and α equilibrium phases identical to the Ni–NiAl–Cr alloys. At higher temperatures the Ni–NiAl–Cr system has γ and β phases similar to the Ni–NiAl–W alloys. (R.V.J.)

20636

VISCOSITY OF LIQUID NICKEL AND ITS ALLOYS WITH COPPER. A. A. Vertman and A. M. Samarin (Inst. of Metallurgy, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 132, 572-5(1960) May 21. (In Russian)

The viscosities of liquid alloys were studied as functions of temperature and composition. Viscosity isotherms of liquid Ni–Cu alloys, with Cu contents from 0 to 100%, were plotted. The results also show that the viscosity of nickel melted in air and containing 0.0048 to 0.0075% oxygen exceeds the viscosity of nickel melted under 10^{-4} mm and containing 0.0025% oxygen. Oxygen content in nickel at 10^{-2} mm pressure was 0.0049% and the viscosity behavior was quite normal. Nickel melted in vacuum crystallized with supercooling. According to published data on Ni with density 7.764 g/cm^3 at 1500°C the dynamic viscosity in vacuum is $\eta = 7.764 \times 0.0053 = 0.0410$ poise. At 1453° the viscosity is 0.042 while the measurements at 1500°C showed 0.041 poise. The viscosity of nickel extrapolated to the melting point is 0.0465 poise. (R.V.J.)

20637

THE CHARACTER OF BETA-PHASE DISINTEGRATION IN ZIRCONIUM ALLOYS. Yu. F. Bychkov, V. N. Maskalets, and A. N. Rozanov. Inzhener.-Fiz. Zhur., Akad. Nauk Belorous. S.S.R. 3, No. 4, 95-8(1960) Apr. (In Russian)

The kinetics of the disintegration of the metastable beta phase in alloys of zirconium with 10% molybdenum and 15% niobium is investigated by measuring the physical properties of alloys during tempering. The connection between the stability of the beta phase and the concentration of outer electrons in the alloy is discussed. (auth)

20638

AN INVESTIGATION OF SINTERING IN A METALLO-CERAMIC ALLOY. A. B. Al'tman and V. N. Sorokina. Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 4, 103-7(1960) Apr. (In Russian)

An experimental investigation was conducted of the process of sintering a metal-ceramic alloy Cu–Ni (30% Cu, 70% Ni). The formation of sintered Cu–Ni from a mixture of copper and nickel powders during sintering is accompanied by a number of physical and chemical processes. These include: reduction of oxides; increase in metal contact area between particles; recovery and recrystallization of copper and nickel particles; formation and homogenization of Cu–Ni solid solution; grain growth; and increase in volume of samples. The sintering of Cu–Ni powders takes place in three stages, depending on the temperature of treatment: (1) 100 to 500°C; (2) 500 to 700°C; and (3) 700 to 1000°C. Formation and homogenization of the solid solution takes place mainly at 500 to 1000°C. At 1000°C the formation of sintered Cu–Ni is practically completed. (auth)

20639

THE MEASUREMENT OF DIFFUSION RATE IN REFRACTORY MATERIALS BY THE ABSORPTION METHOD. A. S. Frenkel, D. M. Shakhtin, and V. D. Kovalev (Research Inst. of Refractory Materials, Khar'kov). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 4, 108-10(1960) Apr. (In Russian)

The possibility is shown of applying the absorption method in the measurement of the rate of diffusion of radioactive iron oxide in refractory materials. In order to apply the absorption method it is necessary to know the value of the absorption coefficient of the beta-radiation used, which depends on a number of factors difficult to calculate. The factors affecting absorption of beta-radiation are analyzed. The relationship between the absorption coefficient and test conditions is established experimentally. (auth)

20640

DISLOCATIONS IN SILICON CARBIDE. S. Amelinckx and G. Strumane (Rijksuniversiteit, Ghent) and W. W. Webb (Union Carbide Corp., Niagara Falls, N. Y.). J. Appl. Phys. 31, 1359-70(1960) Aug.

The dislocation structure of type 6H hexagonal silicon carbide was studied by etching, combined with optical microscopy and by x-ray diffraction microscopy. The validity of the conventional etching technique for identification of the sites of the intersection of dislocations with (0001) surfaces was established. However, high densities of dislocations lying in (0001) planes and heretofore undetected by etching techniques were often observed by diffraction microscopy. Dislocations with [11$\bar{2}$0] vectors were found with evidence for slip both on basal planes and on a "puckered" pyramidal plane. Pileups formed by slip and dislocation walls formed by climb were also observed. Silicon carbide shows many of the characteristics of more conventional plastically deformable materials. (auth)

20641

SPECTRAL EMISSIVITY, TOTAL EMISSIVITY, AND THERMAL CONDUCTIVITY OF MOLYBDENUM, TANTALUM, AND TUNGSTEN ABOVE 2300°K. Robert D. Allen, Louis F. Glasier, Jr., and Paul L. Jordan (Aerojet-General Corp., Azusa, Calif.). J. Appl. Phys. 31, 1382-7(1960) Aug.

The emissivities and thermal conductivities of high purity arc melted molybdenum and tantalum and powder metallurgy tantalum and tungsten were measured between 2300°K and their respective melting points. A method is presented for the determination of spectral and total emissivities from the determination of brightness temperature at the center of an electrically heated rod as a function of heat flow rate. The method does not depend on the experimental achievement of blackbody conditions. Spectral emissivities were also determined by measurement of brightness temperatures at the respective melting points. Thermal conductivities of electrically heated rods were determined by the Jain and Krishnan longitudinal heat flow method. The spectral emissivities of tantalum and tungsten

decrease linearly with increase in temperature. The spectral emissivity of molybdenum is constant. The total emissivities of molybdenum, tantalum, and tungsten increase with increasing temperature. For any of the metals the spectral and total emissivities are closest to each other at the melting point. The melting point of tantalum is significantly lowered by small increase in impurity content. The thermal conductivities of molybdenum, tantalum, and tungsten decrease linearly with increasing temperature. The ranges of spectral emissivity, total emissivity, and thermal conductivity above 2300°K are as follows: Molybdenum $\epsilon_\lambda = 0.30$, $\epsilon_T = 0.271-0.285$, $K = 0.34-0.32$; Tantalum $\epsilon_\lambda = 0.361-0.350$, $\epsilon_T = 0.288-0.324$, $K = 0.15-0.11$; and Tungsten $\epsilon_\lambda = 0.37-0.36$, $\epsilon_T = 0.268-0.352$, $K = 0.38-0.30$. (auth)

20642

DIFFUSION OF DEUTERIUM IN DEUTERON-IRRADIATED COPPER. Mark T. Robinson, A. L. Southern, and William R. Willis (Oak Ridge National Lab., Tenn.). J. Appl. Phys. 31, 1474-82(1960) Aug.

The rate of diffusion of deuterium in metals was studied by measuring the counting rate of neutrons from the $D(d,n)He^3$ reaction occurring in metals irradiated with low energy deuterons. A method of analyzing the time-dependence of the observed neutron counting rate was developed and applied to experiments on Cu in the temperature range −46° to +20°C. It was concluded from the results that grain boundary diffusion was primarily responsible for the movement of deuterium in polycrystalline Cu in this temperature range. The apparent activation energy for diffusion of deuterium in polycrystalline 99.999% Cu was found to be 0.12 ± 0.02 ev/atom. Chemical purity appeared to play an influential role in deuterium diffusion in Cu, the rate in OFHC Cu being significantly lower than that in the purer material. A surface resistance effect, independent of the crystallinity of the specimen but proportional to the deuteron beam current, was found to be of major importance in determining the rate of escape of deuterium from the targets. (auth)

20643

METASTABLE SOLID SOLUTIONS IN THE GALLIUM ANTIMONIDE−GERMANIUM PSEUDOBINARY SYSTEM. Pol Duwez, R. H. Willens, and W. Klement, Jr. (California Inst. of Tech., Pasadena). J. Appl. Phys. 31, 1500(1960) Aug.

Alloys were prepared from stoichiometric gallium antimonide and zone refined germanium. The alloys were cooled rapidly and their resultant structures studied by means of x-ray diffraction. A single phase, with the disordered zinchlende structure, was observed in all of the alloys investigated. (M.C.G.)

20644

THE CONSTITUTION OF THORIUM−ZIRCONIUM ALLOYS CONTAINING MORE THAN 15% ZIRCONIUM AND THE EFFECT OF SOME THIRD ELEMENTS ON THE STABILITY OF THE BODY-CENTRED-CUBIC PHASE IN THESE ALLOYS. J. R. Murray (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Less-Common Metals 2, 1-10(1960) Feb. (In English)

The constitution of thorium-zirconium alloys containing more than 15 at.% zirconium was investigated chiefly by metallographic methods. The decomposition of the high-temperature body-centered-cubic solid solution (β) was found to be markedly affected by the purity of the starting materials. The β phase in alloys prepared from commercial purity thorium and from "hafnium-free" zirconium or from zirconium containing 1 at.% hafnium was found to break down to a $\beta_1 + \beta_2$ solid state miscibility gap which has a maximum at 52.5 at.% zirconium and a temperature of 950 ± 10°C. Such a miscibility gap was not observed in alloys made from iodide thorium. Some observations on the metastable microstructures obtained by quenching from the β field are given together with the crystal structures and lattice parameters of these alloys. The effect of additions of 2 at.% each of cerium, hafnium, indium, titanium, and uranium on the decomposition of the β field in alloys prepared from zirconium containing 1 at.% hafnium was also studied. Indium, titanium, and uranium increase the size of the miscibility gap, indium having the least effect and titanium the greatest. Additions of cerium and hafnium cause the gap to disappear, a smooth β decomposition curve with a point of inflection in the composition range 45 to 55 at.% zirconium being obtained. (auth)

20645

THE EQUILIBRIUM DIAGRAM OF THE SYSTEM MOLYBDENUM−RHODIUM. E. Anderson and W. Hume-Rothery (University Museum, Oxford). J. Less-Common Metals 2, 19-28(1960) Feb. (In English)

The equilibrium diagram of the system Mo−Rh above 1500°C in the composition range 40 to 100 at.% Rh was investigated by a combination of thermal, microscopical, and x-ray methods. The system contains an intermediate c.p. hexagonal or ϵ phase extending from roughly 45 to 82 at.% Rh, the freezing point of which rises to a maximum at about 67 at.% Rh. Rh can dissolve about 15 at.% Mo at high temperatures. The lattice spacing/composition relations of the ϵ phase are such that both a and c spacings diminish with increasing Rh content, but the axial ratio c/a passes through a minimum in the region of 75 at.% Rh. A similar characteristic is shown by the ϵ phase of the system W−Ir, but not by the corresponding phases in the systems Mo−Ir or W−Rh. Other lattice-spacing relations are discussed, and the hardness of the alloys was also determined. (auth)

20646

ALPHA-BETA CYCLING OF URANIUM. J. J. Stobo. (C. A. Parsons and Co. Ltd., Newcastle-upon-Tyne, Eng.). J. Nuclear Materials 2, 97-109(1960) June. (In English)

Experiments on the alpha-beta cycling of the core of a bar of uranium while the rim remains in the alpha phase show that dimensional distortions of the bar occur when more than about 10% of the bar diameter is transformed to beta. The extent of the damage depends on the fraction of the bar diameter transformed (e.g., +0.5% diameter strain with 30% transformed). Damage is not observed to increase with increasing number of cycles between 13 and 100. Tubular specimens suffer more severe damage than solid bars when compared on a basis of the percentage of outside diameter transformed. The striking feature of these results is the large increase in internal diameter. The distortions are dependent on the direction of movement of the interface between the phases, and the detailed results are consistent with a general model of phase-change cycling. Metallographic examination after cycling shows that recrystallization took place in all metal heated to above 560 ± 10°C. No porosity which can be attributed to cycling was detected. (auth)

20647

THE LATTICE SPACINGS OF THORIUM−LANTHANUM ALLOYS. D. S. Evans, G. V. Raynor, and R. T. Weiner (Univ. of Birmingham, Eng.). J. Nuclear Materials 2, 121-8(1960) June. (In English)

The lattice spacing/composition curve for the thorium-lanthanum alloy system was investigated, for comparison with previous work on the thorium-cerium system. The

stringent precautions necessary to minimise contamination (principally by nitrogen) are outlined. The results indicate that face-centred cubic thorium and lanthanum form a complete series of solid solutions; the experimentally determined lattice spacings lie on a smooth and continuous curve, except for a narrow range of composition from about 52 to 60 at % lanthanum, in which erratic results may be obtained. The reason for the scatter at these compositions is thought to lie in an enhanced solubility of nitrogen in the alloys. The lattice spacing curve obtained is not of the same form as that for the thorium-cerium alloys, and the reason for this is discussed in terms of the relative ease with which cerium may change its effective valency in solid solution. (auth)

20648

TRANSFORMATION PROCESSES IN URANIUM–MOLYBDENUM ALLOYS WITH LOW MOLYBDENUM CONTENT. J. Lehmann (Centre d'Études Nucléaires, Saclay, France). J. Nuclear Materials 2, 152-68(1960) June. (In French)

Two mechanisms of α-phase transformation were revealed in uranium-molybdenum alloys with a 0.5 to 4% Mo weight content. In alloys with contents up to 0.9%, the transformation occurs from the α phase with a very important hysteresis. In alloys with contents higher than 0.9%, a lamellar precipitation of the α phase occurs in the γ matrix. The microstructure then shows a small grain. A correlation was established with the equilibrium diagram. The limits of the areas of stability of β and $(\beta + \gamma)$ of the U-Mo diagrams were determined: the maximum of solid solubility in the β phase occurs at 0.9%. (auth)

20649

FRACTOGRAPHIC ASPECTS OF SINTERED URANIUM DIOXIDE. A. Portnoff-Porneuf (Centre d'Études Nucléaires, Saclay, France). J. Nuclear Materials 2, 181-5(1960) June. (In French)

A description is given of the microscopic aspects of cracks in sintered UO_2 and their relation to conditions of preparation and heat treatment. The cracks were introduced by impact at 25°C and were observed with an electron microscope. Identification of the mode of rupture which characterizes the zones of low resistance of UO_2 (i.e., the zones rich in pores) allows distinction between intergranular porosity and an intragranular porosity. The correlation between sintering temperature and the porosity aspect is shown. (T.R.H.)

20650

CLEAVAGE OF URANIUM DIOXIDE. A. Portnoff-Porneuf (Centre d'Études Nucléaires, Saclay, France). J. Nuclear Materials 2, 186-8(1960) June. (In French)

A study of cleavage in large UO_2 monocrystals led to an investigation of cleavage in smaller, less-imperfect specimens prepared in the solid state by grain growth in sintered UO_2. Pellets of UO_2 sintered at 1350°C from a high specific surface powder were heated to 2200°C in H_2 for 2 hours. Monocrystalline particles 0.05 to 1 mm in size were obtained. It was established that UO_2 cleaves along the (111) planes. This was confirmed by radiocrystallography. (T.R.H.)

20651

GROWTH HABIT OF ELECTRODEPOSITED URANIUM DIOXIDE SINGLE CRYSTALS. R. G. Robins (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials 2, 189-90(1960) June. (In English)

Separate single crystals of uranium dioxide were deposited on a platinum cathode by the electrolysis of a solution of uranyl chloride in fused NaCl–KCl eutectic at 840°C under reducing conditions. The crystal habit was determined by goniometric and x-ray diffraction measurements and found to be octahedral. The 111 faces were modified by 100 faces developing at a crystal mass of about 5 mg, further modified by 331 faces appearing at a crystal mass of about 10 mg. (M.C.G.)

20652

α-β THERMAL CYCLING OF URANIUM. W. S. Blackburn (C. A. Parsons & Co. Ltd., Newcastle-upon-Tyne, Eng.). J. Nuclear Materials 2, 191(1960) June. (In English)

It has been suggested that when uranium is thermally cycled into and out of the β phase, there is a contraction along the normal to the phase boundary and identical extensions in the perpendicular directions. This idea was applied to the case of a long hollow tube of inner and outer radii a and b in which the phase boundary moves radially in a symmetrical manner. If a is very small, it will increase with successive cycles allowing a much greater deformation to occur in each subsequent cycle. For a large a, however, the changes in radii would be negligible and, therefore, equal amounts of damage would occur in each cycle. (M.C.G.)

20653

OXIDATION OF URANIUM DIOXIDE IN AIR AT 350–1000°C. K. A. Peakall and J. E. Antill (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials 2, 194-5(1960) June. (In English.)

The oxidation behavior of uranium dioxide pellets was determined at 50° intervals between 350 and 1000°C, using a conventional thermal balance. Each pellet, contained in alumina crucibles, was brought to temperature in pure argon and then oxidized in air at a flow rate of 500 std. cc/min. At 350 to 600°C an induction period was observed which decreased as the temperature was increased. Subsequent oxidation proceeded rapidly at a linear rate, the U_3O_8 falling away as a fine powder. At 650 to 850°C the product appeared to become protective, but breakaway to a linear rate followed after a time which increased as the temperature was raised. Above 900°C the product formed a protective shell around the specimen and no breakaway phenomena were obtained during complete oxidation of the pellet. However, breakaway was obtained upon thermal cycling. (M.C.G.)

20654

INFLUENCE OF THE COMPOSITION OF ETCHING REAGENTS ON THE DEMONSTRATION OF DISLOCATIONS IN ALUMINUM. G. Wyon, J. M. Marchin, and P. Lacombe (Ecole Nationale Supérieure des Mines, Paris). Mém. sci. rev. mét. 56, 549-66(1959) Nov. (In French)

After a study of the micrographic results given by etches based on aqua regia and hydrofluoric acid moderated by butylglycol applied to the examination of aluminum of various purities, it has been found possible to classify these etching solutions into two categories. According to the case, one observes either a comparatively small number of geometrical corrosion figures or, alternatively, much more numerous microfigures, the latter capable of revealing very fine polygonization structures. The effect of the addition of impurities to the etches is also envisaged in relation to the purity of the metal that is being etched. These micrographic methods were applied to the study of the development of polygonized structures in aluminum during thermal cycling. (auth)

20655

EFFECT OF HEAT-TREATMENT ON THE DISPLACE-

MENT OF THE DUCTILE-BRITTLE TRANSFORMATION OBSERVED DURING IMPACT AND COLD-DEFORMATION TESTS ON CERTAIN STEELS. J. Dedieu and R. Delannoy (Centre d'Etudes Vallourec, [Paris]). Mém. sci. rev. mét. 56, 567-81(1959) Nov. (In French)

A generalization is made of the brittleness transition phenomenon to various practical cases met with in the working of tubes-bending, drawing, tensioning, and welding. By means of examples and with various steels (18 per cent ferritic steels, basic-Bessemer mild steel containing titanium, and steels for low-temperature service) it is shown that the nature of the initial heat-treatment (simple annealing or normalization followed by tempering) and the rate of cooling influence the results in a very significant manner. (auth)

20656

FRACTURE TESTS ON STEEL SPECIMENS AFTER CHEMICAL OR CATHODIC SATURATION. J. Dedieu and L. Pennec (Centre d'Etudes Vallourec, [Paris]). Mém. sci. rev. mét. 56, 582-94(1959) Nov. (In French)

Hydrogen saturation was effected on steels used in the petroleum industry in France (N 80, plain with manganese and molybdenum; N 80 alloyed with chromium–molybdenum–vanadium, and J 55 with carbon–manganese). Tensile tests on these steels made after saturation allow one to make a classification in terms of P. Bastien's index of brittleness. From this, one may deduce principles relating to certain elements in the compositions and to the heat-treatment for problems where there is reason to fear the possibility of hydrogen embrittlement. Remarks on inhibitors and passivation are made. (auth)

20657

ON THE BRITTLENESS OF TANTALUM IN THE PRESENCE OF HYDROGEN AT ROOM TEMPERATURE. A. Clause and H. Forestier. Mém. sci. rev. mét. 56, 614-16(1959) Nov. (In French)

Tantalum may present an abnormal brittleness in the presence of hydrogen and this from room temperature on. This brittleness may be observed when small quantities of oxygen are dissolved in the lattice. It appears only in the course of deformation and it seems that the applied stress should equal or exceed the elastic limit of the metal. (auth)

20658

STUDY OF THE BRITTLENESS OF Al–Zn AND Al–Zn–Mg ALLOYS WITH HIGH Zn CONCENTRATION. P. Gobin and J. Montuelle (Ecole Centrale Lyonnaise, Lyon and Centre National de la Recherche Scientifique, [Paris]). Mém. sci. rev. mét. 56, 617-24(1959) Nov. (In French)

The difference in Zn concentration between the depleted region along the grain boundary (light-phenomenon) and the matrix of an Al–Zn alloy is too small to explain the brittleness of this alloy. The study of the influence of polygonization on the brittleness of Al–Zn alloys, and the micrographic study of these alloys supersaturated in vacancies by vacuum evaporation, suggest that the condensation of vacancies at the grain boundary is responsible for brittleness. (auth)

20659

SOME LIMITS TO THE ADDITION OF URANIUM–METAL AND OF URANIUM COMPOUNDS TO FUEL ELEMENTS. A. Boettcher. Mém. sci. rev. mét. 56, 625-8(1959) Nov. (In French)

The different physical and chemical properties of the nuclear fuels uranium metal, uranium dioxide, and uranium monocarbide have a considerable influence on their suitability for use in reactors. The possibilities of deleterious effects which disturb the working of the reactor vary according to its type. The behavior of the various fuels in the case of water-cooled and gas-cooled reactors is examined. (auth)

20660

NOTCH EFFECT ON THE BRITTLENESS OF MILD STEELS. P. E. Lagasse and F. Marquet (Institut pour l'Encouragement de la Recherche Scientifique dans l'Industrie et l'Agriculture, [France]). Mém. sci. rev. mét. 56, 629-39(1959) Nov. (In French)

The acuity of the notch impact specimen shifts the transition zone in different ways according to the type of steel. This effect was experimentally studied by means of tests on different structural steels and combined measurements of energy and fracture appearance. The analysis of data shows that: the notch effect is quite different in mild steel and high strength steels; this influence interferes in the practical use of notch impact tests in view of the classification or reception of high strength steels; the variations are different from the brittleness criteria: energy or crystallinity. The functions derived from the notch effect, tells in favor of impact tests with sharp notch ($r \leq 0.25$ mm) for the routine test of brittleness resistance. (auth)

20661

RESISTANCE TO DRAWING OF GRAPHITES AT HIGH TEMPERATURES. H. E. Martens, L. D. Jaffé, and J. O. Jepson. Mém. sci. rev. mét. 56, 721-30(1959) Dec. (In French)

Tensile properties of graphites were determined at 2200 to 2750°C. Maximum strengths, approximately double room-temperature strengths, were found at 2500°C. Some plasticity was observed above 2500°C with values up to 20% being recorded at 2750°C. Reduction in area was always less than 5%, so elongations greater than 5% caused decreases in density. Strength was greater and elongation smaller when measured parallel to the grain. (auth)

20662

SOME RECENT APPLICATIONS OF THE DIRECT EXAMINATION OF THIN SECTIONS OF METALS BY THE ELECTRON MICROSCOPE. A. Saulnier and P. Mirand. Mém. sci. rev. mét. 57, 91-5(1960) Feb. (In French)

The structures of the Al–Mg, Al–Mg_2Si and Cu–Be alloys were determined by examining thin metal sections with the electron microscope. Direct resolution of the lattice planes of a metal crystal was obtained. The microdiffraction of electrons makes it possible to determine the structural evolution of the single crystals in a polycrystalline aggregate during an annealing treatment, by relating the study of the diffusions outside the Bragg angles to the direct micrographic examination of the fields of the object which give rise to these diffusions. (auth)

20663

AUSTENITE RECRYSTALLIZATION IN STRUCTURAL STEEL AFTER HOT PLASTIC DEFORMATION. Stanislaw Gorczyca. Mém. sci. rev. mét. 57, 153-8(1960) Feb. (In French)

Plastic deformation was obtained by forging on specimens of a steel: 0.36% C, 0.72% Mn, 0.29% Si, 1.43% Cr, 1.46% Ni, 0.23% Mo, by temperatures from 850 to 1050°C. The recrystallization process was observed microscopically, after quenching and etching with teepol-picric acid solution. The established speed of growth of the new grains of austenite was $V = K \cdot e^{-Q/RT}$, where $K = 8.9 \cdot 10^8$ mm/s and Q = 61,000 cal/g-atom. (auth)

20664

THE RUPTURE ASPECT OF DEAD-MILD STEEL CONTAINING HYDROGEN. Marguerite Azou, Pierre Azuo, and Paul Bastien. Mém. sci. rev. mét. 57, 159-60(1960) Feb. (In French)

An electronic microfractographic study was made of the rupture aspect of a steel with and without hydrogen content. After vacuum heat treatment and electropolishing the steel samples (0.08% C, 0.03% S, 0.01% P, 0.35% Mn, and 0.04% Si) were electrolytically charged with H. After rupture, carbon replicas for electron microscopy were made. The study revealed information on the effects of H on rupture of steel at ambient temperatures and liquid air temperature. (T.R.H.)

20665

INFLUENCE OF DEFORMATION AND DEFORMATION RATE ON THE RECRYSTALLIZATION OF 25% Cr STEEL (FERRITIC) AFTER HOT PLASTIC DEFORMATION. C. Rossard and P. Blain (Institut de Recherches de la Sidérugie, Saint-Germain-en-Laye, France). Mém. sci. rev. mét. 57, 173-8(1960) Mar. (In French)

The structure obtained by hot deformation changes during holding at temperature following this deformation. There is a threshold of deformation above which recrystallization occurs after an incubation period which varies within wide limits with the deformation itself, the rate of deformation, and the temperature. (auth)

20666

A COMPARATIVE STUDY OF TITANIUM AND ZIRCONIUM BY THE DILATOMETRIC METHOD. G. Cizeron and P. Lacombe (Ecole Nationale Supérieure des Mines, Paris). Mém. sci. rev. mét. 57, 179-93(1960) Mar. (In French)

The metals Zr and Ti from different sources (with different contents in impurities) were compared by the dilatometric method. Their behavior was studied during the passage from the cold-worked state to the recrystallized one by annealing in the a -field or during the $\alpha \rightleftharpoons \beta$ transformation. The presence of small contents of Fe in Zr and Si in Ti, if these contents are superior to the limit of solubility, can be revealed by some dilatometric anomaly. This anomaly corresponds to an eutectoid reaction in the phase diagram of each system Zr-Fe and Ti-Si. The allotropic transformation itself occurs in a smaller temperature range if the metal is purer. If during the cooling the metal undergoes a small stress of compression, the sense of the $\beta \rightarrow \alpha$ dilatometric anomaly is inversed. A crystallographic mechanism, similar to that which has been proposed by W. Burgers, is described in order to explain this anomalous behavior. (auth)

20667

PLASTIC STRAIN AND FRACTURE OF STEEL SPECIMENS SUBJECTED TO CYLINDRICAL STATE OF STRESS. APPLICATION TO THE STUDY OF HYDROGEN EMBRITTLEMENT OF STEEL. K. Liang, P. Azou, and P. Bastien (Ecole Centrale des Arts et Manufactures, Paris). Mém. sci. rev. mét. 57, 203-14(1960) Mar. (In French)

Cylindrical specimens of steel were tested in tension and a simple method of determining the tension stress-strain curve was proposed. The validity of this curve was extended to the case where the state of stress to which the specimen is subjected is cylindrical. The study of fracture has lead to the definition of a criterion for fracture. The results of this work were applied to the study of hydrogen embrittlement of steel and conclusions were drawn from experiments. (auth)

20668

STRUCTURAL HARDENING AND REVERSION IN THE ALUMINUM–NICKEL ALLOYS. Henry Martinod and Jean Calvet (Office National d'Etudes et Recherches Aéronautiques, Châtillon-sous-Bagneux, France). Mém. sci. rev. mét. 57, 325-37(1960) May. (In French)

Isothermal hardening after quenching in the aluminum-nickel alloys is a slow phenomenon which preserves the same general character at all the temperatures at which it occurs. It is influenced in a continuous way by an initial holding at a different temperature. A limited reversion may take place; it accelerates the later changes under the thermal conditions. The experimental data lead to the hypothesis of a division of the solid solution of the same nature over a wide range of temperature. (auth)

20669

DISCONTINUOUS GROWTH OF CRYSTALS IN THE ALUMINUM–COPPER ALLOYS. J. Calvet and C. Renon (Office National d'Etudes et Recherches Aéronautiques, Châtillon-sous-Bagneux, France). Mém. sci. rev. mét. 57, 345-62(1960) May. (In French)

Discontinuous crystal growth was studied in very pure Al-Cu alloys. It is shown that precipitation has a dominant influence in this case. Subsequently the effect of manganese and zirconium additions to these alloys was studied. (auth)

20670

THE SUBSTRUCTURES IN ALUMINUM AFTER SOLIDIFICATION AND COOLING AT ROOM TEMPERATURE. U. Benedict and H. J. Seemann (Universität des Saarlandes, Saarbrücken, Ger.). Mém. sci. rev. mét. 57, 363-70(1960) May. (In French)

Three types of sub-grains are observed in aluminum after crystallization and cooling at room temperature, according to the rates of crystallization and of cooling used and to the purity of the metal. The substructures are examined micrographically and by an x-ray technique. A special type of grain boundary migration is described. (auth)

20671

EFFECT OF POLYMORPHIC TRANSFORMATION ON THE DIFFUSION IN TITANIUM. S. Z. Bokshteĭn, S. T. Kishkin, and V. B. Osvenskiĭ. Metalloved. i Termichesk. Obrabotka Metal. No. 6, 21-6(1960) June. (In Russian)

The low working temperature of 450 to 500°C of Ti-base alloys is not warranted in view of the high melting point of the metal. This question was studied by determining the diffusion velocity of Sn-113 in the alpha and beta modifications of Ti. This isotope was chosen because it is a good radiochemical indicator and because it does not affect the alpha $\rightleftharpoons$ beta transformation. The activation energy of the diffusion process of Sn in pure beta-Ti was found to be about 2.5 times higher than in the alpha-modification. Similar results were obtained with technical grade material, in which the diffusion velocity was decreased. The value of the activation energy in technical Ti increases from 29.9 to 38 kcal/g atom for alpha-Ti and from 78.6 to 86.5 kcal/g atom for the beta phase, indicating an energy change in the crystal lattice. Structural changes have a great effect on the diffusion process, even if no phase change takes place. The difference is attributed either to different stability of the interatomic bond or to the basically different structure of the alpha-Ti. (TTT)

20672

A HIGH TEMPERATURE RESISTANT BETA-TITANIUM BASE ALLOY. E. V. Petunina (Central Research Inst. of Ferrous Metallurgy, USSR). Metalloved. i Termichesk. Obrabotka Metal. No. 6, 27-30(1960) June. (In Russian)

In investigating the properties of Ti alloys based on the beta phase, a high-alloy material was prepared by hydrostatic pressing of the component oxides, reducing them in

situ, thus assuring even composition. The alloy, designated as IMP-10, contained 13% V, 11% Cr, and 3% Al. The alloy remained plastic, even when fast-cooled. The tensile strength was always higher than 100 kg/cm^2 and elongation was at least 20%, while alpha-phase material had a tensile strength of only 80 to 85 kg/cm^2 being also much less plastic. The beta-Ti alloy remained stable after annealing, hammering, and quenching. The tensile strength increased after quenching and aging, but samples which were not previously aged had a higher tensile strength for a short time. X-ray diffraction studies of aged specimens revealed little change upon aging at 200°C, while treatment at 300°C caused hardening and at 400°C a microdispersed phase appeared. Aging increased the tensile strength to 177 kg/cm^2. (TTT)

20673

HEAT TREATMENT AND MECHANICAL PROPERTIES OF Ti ALLOYS CONTAINING 5 to 13% ALUMINUM. V. N. Moiseev. Metalloved. i Termichesk. Obrabotka Metal. No. 6, 30-9(1960) June. (In Russian)

It is known that the addition of Al to Ti alloys stabilizes the alpha phase and increases heat resistance. It was found that in alloys containing more than 9% Al the heat treatment affects the mechanical properties of the alloy to a considerable degree. Specimens annealed at 800°C and then air-cooled became brittle, while water quenching resulted in an elongation ranging from 15 to 20%. The effect of temperature is connected with the temperature dependence of the solubility of Al in alpha-Ti. The mechanical properties of annealed samples containing more than 7% Al were improved by heat treatment, while alloys containing 9 to 10% Al exhibited brittle fracture upon elongation testing. Water quenching from temperatures ranging from 700 to 1100°C improved the plastic properties of all samples containing 8 to 11% Al. In order to have a beneficial effect on the properties of alloys with 11% Al, the annealing temperature must be increased to 1200°C, resulting in an elongation ranging from 4 to 7%. Alloys having 12 or 13% Al remained brittle after the heat treatment. Samples containing more than 7% Al and aged at 450°C for more than 100 hours also became brittle, while aging at lower temperatures did not affect the mechanical properties. Addition of 3% Zr, Cr, or Mo to alloys containing 9% Al reduced their thermal stability. (TTT)

20674

EFFECT OF GRAIN SIZE ON THE MECHANICAL PROPERTIES AND NOTCH SENSITIVITY OF TECHNICALLY PURE TITANIUM. V. I. Chernetsov. Metalloved. i Termichesk. Obrabotka Metal. No. 6, 40-2(1960) June. (In Russian)

The gas content of technically pure Ti was considerably reduced by annealing at 950°C in vacuum for 5 hrs, resulting in a H concentration of 0.0017% and in N and O concentrations of 0.042 and 0.075%, respectively. The specimens were then hot-rolled, soaked at 200°C, and water-quenched in order to obtain a fine grain structure, determining the grain size by actual counting on the microslide. In the temperature interval from 750 to 900°C, corresponding to the region of the alpha phase, titanium does not exhibit a noticeable tendency toward grain growth, while its beta modification existing within the range of 900 to 1100°C, was found to form large grains. The mechanical properties of the metal were influenced very little by the structural changes occuring during slow cooling from the temperature zone of the beta phase to the region of the alpha modification, although the grain size changed considerably. Ultimate hardness and tensile strength at 20° and at −196°C were unaffected. The plasticity of smooth specimens decreased slightly but that of notched and rough specimens remained unchanged. The notch sensitivity was also unaffected by the change of the grain size. It can be concluded that technically pure titanium is not brittle and is insensitive toward variations of grain size. (TTT)

20675

DISLOCATIONS IN LAYER STRUCTURES. V. A. Phillips and P. Cannon (General Electric Research Lab., Schenectady, N. Y.). Nature 187, 313-14(1960) July 23.

Examinations of cleavage fragments of graphite and molybdenite were made for evidence of dislocations. It was found that the interpretation of the electron micrographs from such materials is rendered difficulty by the presence of contrast effects due to extraneous surface detail and by the presence of sub-grain boundaries. The results of studies of the micrographs are discussed. (B.O.G.)

20676

DISLOCATION LOOPS DUE TO QUENCHED-IN POINT DEFECTS IN GRAPHITE. S. Amelinckx and P. Delavignette (Centre d'Etude de l'energie Nucléaire, Mol, Belg.). Phys. Rev. Letters 5, 50-1(1960) July 15.

Dislocation loops were induced in natural graphite crystals by heating to 2700 to 3000°C for 2 min by electron bombardment, cooling, and annealing at 1200°C. Transmission electron micrographs revealed large dislocation loops in the c plane having a stacking fault of small energy, and the Burgers vector was found to be not perpendicular to the c plane. It is concluded that the point defects causing the loops are vacancies and not interstitials. (D.L.C.)

20677

THE ATOMIC ARRANGEMENT IN THE SOLID STATE OF THE ALUMINUM–ZINC SYSTEM. A. Münster and K. Sagel (Metall-Laboratorium der Metallgesellschaft A. G., Frankfurt am Main). Z. physik. Chem. (Frankfurt) (N.S.) 24, 217-39(1960) May. (In German)

The statistical atomic distribution of the solid Al–Zn system was determined with the aid of diffuse x-ray small-angle scattering. Experimental methods and evaluations were described. It is shown that in the range investigated (12 to 50 at. % Zn and 340 to 380°C) similar neighbors are preferred (cluster formation). The excess of similar neighbors at 380°C (about 30°C over the critical temperature) is still at the greatest for the critical concentration. With decreasing temperature short-range order increases. In approximations on the decomposition curve, local decompositions occur. (tr-auth)

20678

THE LIMITS OF HOMOGENEITY OF CHROMIUM DISILICIDE AND ITS ELECTRICAL PROPERTIES. V. P. Trusova, V. S. Kutsev, and B. F. Ormont (Karpov Inst. of Physics and Chemistry, USSR). Zhur. Neorg. Khim. 5, 1119-22(1960) May. (In Russian)

Silicides of the transition metals are stable to oxidation on heating in air and possess high values of thermal electromotive force for direct conversion of heat into electricity. Synthesis of compounds ranging in composition from CrSi to $CrSi_{2.5}$ were carried out by heating chromium metal (99.96%) and Si (99.99%) in evacuated quartz tubes at 1100 to 1150°C for 11 hours and cooling slowly to room temperature in the furnace. Chemical analyses were run for Cr and Si content, but sometimes only Cr was determined and the Si content was obtained by difference. It was shown that free silica dissolves in 2 N NaOH at 90°C in 25 to 30 minutes while the solution of $CrSi_2$ under these conditions is 250 times slower. X-ray and chemical analyses showed that there was no free silica

in any of the preparations. X-ray analyses showed no reflections due to CrSi at a range of composition from $CrSi_{1.99}$ to $CrSi_{2.29}$. The coefficient of thermal electromotive force α was found to vary from 90 μv/deg. to 110 μv/deg. for these compositions. Heating the disilicides in air for four hours at 700°C and four hours at 900°C had no effect on the values of the thermal electromotive force coefficients. Chemical analyses showed that no free silica is formed on quenching $CrSi_{2.2}$ from 1100°C to room temperature or on annealing $CrSi_{2.2}$ at 870°C for 4.5 hours and at 600°C for five hours. The value of α is a minimum at 400°C. (TTT)

20679

THE HEAT OF REACTION OF THE TRANSITION OF σ-PHASE TO AN α-SOLID SOLUTION IN THE IRON–CHROMIUM SYSTEM. I. I. Kornilov and N. M. Matveeva. Zhur. Neorg. Khim. 5, 1387-8(1960) June. (In Russian)

The $\alpha \rightarrow \beta$ transition of iron (magnetic change) and the $\beta \rightarrow \gamma$ transition of iron, with heats of reaction of 0.27 and 0.35 kcal/g-atom respectively, were used as thermographic standards of comparison in determining the heat of reaction of Fe-Cr alloys with an accuracy of 3 to 5%. The Fe-Cr alloys were prepared from electrolytic chromium and Armco iron in an electric arc furnace with a non-consumable electrode in an atmosphere of argon. The alloys were tempered by holding for 48 hours at 1200°C. With a chromium content of 45.74 to 49.88 at.%, the alloys showed complete conversion of the σ-phase on holding at 700°C for 500 hours as indicated by a loss in ferromagnetic properties and a sharp increase in brittleness and hardness. With 50.82 at.% chromium the alloy had to be held at 700°C for 700 hours for complete conversion to the σ-phase. The heat of reaction for the $\sigma \rightarrow \alpha$ transition depends on the composition of the σ-phase and varies from 1.06 ± 0.05 kcal/g-atom for 45.74 at.% chromium to 0.75 ± 0.05 kcal/g-atom for 50.82 at.% chromium. The alloys with the fastest rate of conversion had the highest heat of reaction and the highest temperature of conversion. The conversion temperature for the $\sigma \rightarrow \alpha$ transition was 850°C for the 45.74 at.% chromium and 820°C for the 50.82 at.% chromium. (TTT)

20680

GRAPHITE AND ITS CRYSTAL COMPOUNDS. A. R. Ubbelohde and F. A. Lewis. New York, Oxford University Press, 1960. 226p. $5.60.

A survey is given of the chemistry and physical properties of graphite. The relationships of graphite with its crystal compounds that are structurally more complex and chemically less pure are described. Access to more specialized treatments is provided by an ample bibliography to recently published literature. (B.O.G.)

20681

TERNARY ALLOY-CONTAINING PLUTONIUM. (to U. S. Atomic Energy Commission). British Patent 840,136. July 6, 1960.

A method is presented for preparing ternary alloys consisting of from 2 to 25 at.% Mo and Zr with the remainder being U and Pu in the atomic ratio from 1:1 to 9:1 U to Pu. (W.L.H.)

Radiation Effects

20682 ANL-5025

Argonne National Lab., Ill.

THERMAL ANNEALING OF NEUTRON INDUCED DISCOMPOSITION IN ARTIFICIAL GRAPHITE. III. HEATING-DURING-IRRADIATION EXPERIMENTS. T. J. Neubert. Apr. 13, 1953. Decl. Feb. 24, 1960. 26p. Contract W-31-109-eng-38. OTS.

The pile-induced changes in electrical resistivity and elastic modulus of graphite were investigated as functions of sample temperature during bombardment and the amount of bombardment. The data were for relatively low bombardment times (up to ~20 L-units) and temperatures (up to 340°C) and not sufficiently extensive to permit unequivocal conclusions. However, they suggested strongly that heating during irradiation produced less total change in the electrical resistivity than low-temperature irradiation followed by annealing at the same higher temperature, at least for temperatures in excess of ~200°C. In general, this difference appeared to become more pronounced as the temperature of irradiation and the amount of irradiation were increased. The same condition apparently applied to the elastic modulus for bombardments in excess of ~15 L-units, although there was some indication that the reverse was true for very low bombardments. (auth)

20683 BSR-275

Bendix Aviation Corp. Bendix Systems Div., Ann Arbor, Mich.

M & TC SYSTEM STUDY. Interim Engineering Report No. 12 for February 1, 1960 to May 31, 1960. 168p. Contract AF33(600)-35026. (BSC-13271).

The current effort is described in a program to provide designs for airborne electronics equipment which must operate reliably in an environment that includes nuclear radiation. Particular attention is paid to equipment comprising the Mission and Traffic Control (M&TC) subsystem which provides the function of long and short range communications, short range navigation, approach and landing aids, emergency beacons, and identification friend or foe. (auth)

20684 HW-57883

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SUMMARY OF TESTING FOR THE ELMO-7 TEST LOOP, JANUARY 1 TO DECEMBER 31, 1958. D. R. Doman. Jan. 5, 1959. 27p. Contract AT(45-1)-1350. OTS.

The Elmo-7 test loop is a pressurized high temperature recirculating water facility capable of testing to maximum conditions of 600°F and 2000 psi at various water qualities. The results of various tests on fuel element cladding, fuel element design, reactor piping components and sealing arrangements, and various types of gaskets, performed in support of the KER pressurized water recirculation test facility, the Plutonium Recycle Test Reactor, and the New Production Reactor, are presented. (C.J.G.)

20685 IBM-60-911-5

International Business Machines Corp. Federal Systems Div., Owego, N. Y.

FINAL REPORT ON SOME EFFECTS OF PULSED NEUTRON RADIATION ON ELECTRONIC COMPONENTS. Period Covered: May 1, 1959 to November 30, 1959. Jan. 1960. 85p. Contract AF33(600)-31315. (WADC-TR-60-71).

Data are given on the effects of pulsed radiation on cables, capacitors, resistors, thyratrons, voltage regulator tubes, and semiconductor circuits. Experiments which were performed on transistors and gas-filled capacitors are described. (auth)

20686 NAA-SR-5062

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

DIRECT OBSERVATION OF FAST NEUTRON DAMAGE IN

GOLD FILMS. Alexander Grenall. July 15, 1960. 18p. Contract AT-11-1-GEN-8. OTS.

Evidence is presented from transmission electron microscopy to support Brinkman's theoretical prediction that displacement spikes are produced in heavy metals by suitable irradiation. Examination of vacuum deposited gold samples, consisting of discontinuous films of discrete particles, revealed the presence of small black spots in the particles after an irradiation of 4.2×10^{17} fast neutrons per cm^2. The mean density of displacement spikes observed, 3×10^{16} per cm^3, corresponds well with an estimate of 9×10^{16} per cm^3 based on theory. The average diameter of the displacement spikes was found experimentally to be 65 ± 7 A, in good agreement with the theory. (auth)

20687 ORNL-2947(p.82-6)

Oak Ridge National Lab., Tenn.

THORIUM OXIDE IRRADIATIONS. J. P. McBride and O. O. Yarbro. p.82-6 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

Two series of thorium oxide powders that were fired at 650, 800, 900, 1100, and 1500°C and then irradiated 16 and 22 months in an LITR lattice position were recovered for examination. The 650, 800, and 900°C-fired samples in both series were red and had sintered into hard agglomerates; the 1100°C-fired samples were off-white powders; and the 1500°C-fired samples were blue powders. Radiochemical analyses of the 16-month irradiated oxides and flux monitors indicated the neutron flux to have ranged from 1.7 to 2.5×10^{13}. The irradiation produced a marked decrease in surface area for the lower-fired materials, but no change in surface area was observed for the 1500°C-fired material. The estimated maximum temperature of all oxides while being irradiated was <300°C. Thus the observed effect of irradiation was a sintering action comparable to about a 1500°C calcination. A heavy-water slurry of >25-μ 1000°C-fired thoria spheres containing 0.5% natural uranium that was irradiated 52 days in the C-43 facility in the LITR at temperatures from 180 to 280°C was recovered. A dried plug, composed of more than half the original solids, was found at the top of the irradiation autoclave, apparently deposited by the reflux conditions introduced by the method used for temperature control during irradiation. Irradiation of a settled bed of 0.2-in.-diam thoria pellets in heavy water was initiated, and hot-cell techniques for evaluation of irradiation effects are under development. (auth)

20688 SCR-140

Sandia Corp., Albuquerque, N. Mex.

SANDIA CORPORATION BIBLIOGRAPHY — RADIATION EFFECTS. Dec. 1959. 108p. OTS.

A comprehensive bibliography with abstracts and title lists is presented on radiation effects on materials, dosimetry, health physics, nuclear facilities, and associated topics. References to radiation effects on electronic materials, components, and systems, metals, alloys, ceramics, propellants, explosives, organic chemicals, including fuels, lubricants, and other petroleum products, and polymeric materials, including elastomers, plastics, and adhesives are given. References to shielding are included. (C.J.G.)

20689 ZFK-WF-2

Germany. Zentralinstitut für Kernphysik, Dresden.

DIE BESTRAHLUNG VON CdS MIT THERMISCHEN NEUTRONEN. (Irradiation of CdS with Thermal Neutrons). O. Hauser and V. Köhler. Sept. 1959. 13p.

CdS crystals were irradiated with thermal neutrons and the photoconductivity measured according to the spectrum of the penetrating light. The neutron irradiation led to a high increase of crystal sensitivity. As examination revealed, the changed photoconductivity in irradiated CdS crystals is caused by formation of In and Sn atoms. (auth)

20690

MAGNETIC COUPLING HYSTERESIS EFFECT OF DIFFUSION IN PURE IRON IRRADIATED WITH NEUTRONS. Pierre Moser, Daniel Dautreppe, and Pierre Brissonneau (Centre d'Études nucléaires et Laboratoire d'Électrostatique et de Physique du Métal, Grenoble, France). Compt. rend. 250, 3963-5(1960) June 13. (In French)

The magnetic coupling hysteresis effect of diffusion has permitted the detection of faults with an activation energy of 1.2 ev after irradiation in a reactor at room temperature. After irradiation at 78°K, faults were found diffusing towards 90°K with an activation energy of 0.3 ev. (tr-auth)

20691

TRANSITORY ELECTRICAL PROPERTIES OF n-TYPE GERMANIUM AFTER A NEUTRON PULSE. H. J. Stein (Sandia Corp., Albuquerque, N. Mex.). J. Appl. Phys. 31, 1309-13(1960) Aug.

The stability of neutron bombardment damage in Sb-doped Ge was investigated by making continuous measurements of the electrical conductivity and Hall mobility following a neutron pulse. Measurements were made in the temperature range from 77° to 308°K with a time resolution of 1 sec. At temperatures near 195°K an initial decrease in conductivity and mobility was followed by an additional decrease which exhibited nearly second-order kinetics. At 273°F and above, an initial decrease in conductivity and mobility was observed, but was followed by a recovery consistent with an activation energy of 0.68 ev. The void region model of Gossick and Crawford was employed to explain the initial decrease in mobility and a major portion of the initial decrease in conductivity. The transitory changes in mobility and conductivity after the neutron pulse are considered as changes in the void volumes. (auth)

20692

ON THE PRODUCTION OF DISPLACED ATOMS BY THERMAL NEUTRONS. R. M. Walker (General Electric Research Lab., Schenectady, N. Y.). J. Nuclear Materials 2, 147-51(1960) June. (In English)

The production of displaced atoms by processes resulting from thermal neutron capture are discussed. The results of an approximate calculation are presented which indicate that, in a number of elements, the number of displaced atoms produced by the recoil following capture γ-ray emission may form an appreciable fraction of the total number of displaced atoms produced in a reactor experiment. The unique features of the radiation damage produced by thermal neutrons are noted, and some considerations attendant upon isolating and using such reactions in damage experiments are discussed. (auth)

20693

SYMPOSIUM ON SOLID STATE CONDUCTIVITY. I. RADIATION-INDUCED CONDUCTIVITY. G. F. J. Garlick (Univ. [Coll.] of Hull, Eng.). Phys. in Med. Biol. 4, 325-33(1960) Apr.

Photoconducting crystals such as cadmium sulfide are finding increasing use as detectors for x and γ radiation, either in simple form or as components of solid state image amplifiers. An appreciation of the fundamental processes of free carrier production by radiation, factors influencing carrier life-time and those affecting recombination of carriers can prove valuable in assessing the optimum performance likely for such crystals. Such processes can be revealed by relatively simple measure-

ments of relations between photocurrents or induced currents and excitation intensity of incident radiation, between current and voltage, current and temperature and photon energy, and of decay of current with time after removal of stimulus. Spectral response curves reveal the presence of surface states deleterious to long carrier life-times. Linear relations between current and radiation intensity reveal the presence of trapping states and a performance below optimum although the linearity may be a very desirable feature for dosimetry. Single crystals of cadmium sulfide show better behavior than powder form layers with respect to response speed. A major problem is the quality control of crystals in production and the ability to introduce desired types of recombination centers for carriers. This prompts turning of attention to other possible photoconductors. Some suggestions include cadmium telluride and perhaps mercury sulfide which offer in addition higher stopping powers. Cadmium telluride can be synthesized and doped in the molten form and grown into relatively large crystals. A further possibility is the stabilization of silver halide conductivity counters by introduction of appropriate divalent impurities. An appendix gives some practical data on cadmium sulfide. (auth)

20694

SYMPOSIUM ON SOLID STATE CONDUCTIVITY. V. THE TEMPERATURE DEPENDENCE OF GAMMA RAY INDUCED CONDUCTIVITY IN CADMIUM SULPHIDE SINGLE CRYSTALS. C. G. Clayton and G. A. Briggs (Wantage Research Lab., Berks, Eng.). Phys. in Med. Biol. 4, 358-69 (1960) Apr.

The radiation induced current in cadmium sulfide single crystals was observed over an operating temperature range of +25 to −120°C. Change in sensitivity and decay were related to some electrical properties of the crystals. The results showed that the sensitivity decreased by a factor of about two between room temperature and −50°C, and then increased to about the same value at −85°C as at room temperature. The temperature at which this minimum sensitivity occurred was the same as that at which a maximum thermo-stimulated current was observed when the crystal was uniformly heated following irradiation at −120°C. These results confirmed that the Fermi limit was passing through a dense region in the energy distribution of traps. The decay time of the crystals does not vary inversely as the sensitivity when the temperature is changed: at −50°C the decay time was found to be a maximum and seven times greater than at room temperature, while at −85°C it had decreased again so that it was only twice that at room temperature. The relationship between induced current and dose-rate was found to be approximately linear throughout the temperature range investigated. (auth)

20695

PROCESS FOR MODIFYING FIBRES OR FILMS FROM NATURAL OR REGENERATED NATURAL POLYMERS. (to E. I. Du Pont de Nemours & Co.). British Patent 834,557. May 11, 1960.

A method is presented for modifying the properties of polymer fibers or films and consists of subjecting such materials in contact with modifiers to ionizing radiation. In this way, properties may be modified permanently without the disadvantages of chemical and mechanical methods of attaching the modifier to the material, e.g., degradation and effect impermanency. The material can be kept out of contact with O_2 or H_2O during irradiation by means of an inert gas, a film of polyethylene or Al, or an antioxidant chemical. The irradiation effect can sometimes be increased by the presence of some substance which converts the absorbed radiation into a more effective form, e.g., $CaWO_4$, ZnS, and Pb phosphors. The temperature is usually kept at 0 to 75°C during irradiation by cooling. The material may be irradiated at varying depths, as in films, yarns, film rolls, fabric bolts, and bales; particle radiations (e.g., electrons) are useful for thin-layer irradiations, while γ and x rays are useful for massive substrate irradiations. The necessary energy ranges are given. Some examples are given of the possible effects that may be obtained with different materials, modifiers, and radiations. Some of the materials that may be irradiated are cellulose, protein, and isoprene polymers; natural fibers such as cotton, flax, hemp, silk, wool, fur, and hair; rubber, cellulose derivatives, and films of film-forming natural fats. The modifiers to be attached to the material by irradiation may be low or high molecular weight organic compounds, e.g., alcohols, diamines, ethylenic polymerizable compounds, acrylonitrile, polyalkylene glycols, and polyethers. (D.L.C.)

20696

METHOD OF MAKING CELLULAR POLYETHYLENE. (to Dow Chemical Co.). British Patent 837,504. June 15, 1960.

A process is described for the preparation of cellular polyethylene. The polyethylene is subjected to radiation under pressure of a volatile organic fluid at temperatures between 100 and 200°C. The pressure and temperature are applied until the polymer is a uniform fluid and then the pressure is suddenly released with the resulting formation of a cellular polyethylene body. (W.L.H.)

20697

"AN IMPROVED IRRADIATED POLYETHYLENE." (to Esso Research and Engineering Co.). British Patent 840,070. July 6, 1960.

A method is presented for preparing polyethylene with a melting point above 200°C. The method consists of admixing polyethylene with a non-conjugated divinyl aromatic hydrocarbon and irradiating the admixture with high-energy radiation. (W.L.H.)

PHYSICS

General and Miscellaneous

20698 AD-232292

Johns Hopkins Univ., Baltimore. Radiation Lab.

PAPERS PRESENTED AT SYMPOSIUM ON SOLID STATE AND PLASMA PHYSICS, NOVEMBER 3, 4, 1959. Jan. 1960. 300p. Contract AF33(616)-3374. (JHU/RL-TR-AF-73).

Eighteen papers were presented on masers, topics in solid state physics, solid state materials research, and plasmas. (W.D.M.)

20699 AD-234128

Pennsylvania State Univ., University Park. Ionosphere Research Lab.

ELECTRON DENSITIES IN THE UPPER IONOSPHERE FROM ROCKET MEASUREMENTS. Scientific Report No. 126. John S. Nisbet. Dec. 10, 1959. 177p. Rocket Project. Contract DA-36-061-ORD-577.

An investigation of electron densities in the upper F region of the ionosphere by rockets (those with satellite launch missions or intermediate range ballistic missiles) is described. Investigations were confined to propagation

measurements between the missiles and ground stations and to methods which require radio links with the missile for telemetry and tracking purposes only. A matrix method is described for analyzing oblique dispersion measurements to determine vertical electron density height profiles. Horizontal gradients, refraction, and the varying ray path zenith angles in the ionosphere are taken into account. Two methods of measuring ionospheric dispersions were employed and compared: Faraday rotation and a method using the difference between the apparent positions of the missile obtained by two tracking systems operating on different frequencies. (C.J.G.)

20700 AFCRC-TR-59-118(Pts. I and II)
Air Force Cambridge Research Center, Bedford, Mass.
THE McGILL SYMPOSIUM ON MICROWAVE OPTICS. A Collection of 61 Papers. PART I. MICROWAVE OPTICS. PART II. DIFFRACTION AND SCATTERING. R. S. Karasik, ed. Apr. 1959. (Pt. I, 138p. and Pt. II, 241p.). OTS.

These Parts may be further identified as (Pt. I, AD-211499; PB-161450 and Pt. II, AD-211500; PB-161451).

Sixty-one papers were presented at the conference on microwave optics held at Montreal, June 22-25, 1953. Topics covered included lenses and reflectors, caustics and aberrations, Fourier transforms and communication theory, microwave optics of artificial dielectric media, microwave interferometry and the Faraday effect, electromagnetic theory, general techniques, the geometric optics limit in diffraction theory, asymptotic developments, diffraction by apertures, scattering by specific bodies, radiation patterns of antennas, and experimental studies. (W.D.M.)

20701 AFBMD-TR-60-26
Avco Corp. Avco-Everett Research Lab., Everett, Mass.
RELAXATION PROCESSES AND REACTION RATES BEHIND SHOCK FRONTS IN AIR AND COMPONENT GASES. Research Report 83. K. Wray, J. D. Teare, B. Kivel, and P. Hammerling. Dec. 1959. 32p. Contracts AF04(647)-278 and DA-19-020-ORD-4862.

The Avco-Everett research program on nonequilibrium phenomena in normal shocks is summarized. Three classes of experiments are described: (1) absorption of ultra-violet radiation, (2) emission of optical radiation, and (3) microwave absorption and reflection. The use of these measurement techniques in unraveling the complex phenomena that occur in the non-equilibrium region of normal shocks is outlined. The current values used to correlate the experimental data for the chemical and electronic rate constants are quoted. (auth)

20702 AFOSR-TN-60-519
Rutgers Univ., New Brunswick, N. J. Coll. of Engineering.
X-RAY STUDY OF LATTICE DEFECTS IN FATIGUED SINGLE CRYSTALS. Technical Note No. 2. A. Shrier, S. Weissmann, and J. J. Slade, Jr. July 1960. 58p. Contract AF49(638)-17.

Annealed silver single crystals grown from the melt with a (111) orientation were subjected to cyclic bending and were studied below and above the fatigue limit (10^7 cycles). High resolution x-ray methods were employed which included the Schulz reflection topography method, the x-ray reflection microscopy method with continuous specimen rotation, the double-crystal diffractometer method supplemented by x-ray reflection microscopy, and the divergent x-ray beam back-reflection method. The x-ray studies were carried out as functions of increased number of cycles and position of specimen areas and supplemented by microhardness investigations. It was possible to discern three distinct stages in low-stress fatigue: (1) a primary stage associated with cyclic work-hardening resulting from intersecting slip and the possible formation of Cottrell-Lomer locks; (2) a secondary stage associated with a "softening" process and presumably with a partial "unlocking" of the Cottrell-Lomer locks; and (3) a tertiary stage manifested by a characteristic x-ray line broadening and absence of a distinct substructural break-up. This tertiary stage was interpreted to be associated with submicroscopic void formation. In high-stress fatigue the effects of all the three stages were juxtaposed and the characteristic fatigue phenomena developed at a higher rate. (auth)

20703 AFOSR-TN-60-635
Illinois. Univ., Urbana.
COLOR CENTER REACTIONS IN THE ALKALI HALIDES. Technical Note No. 2 on RESEARCH ON THE ELECTRONIC PROPERTIES OF NONMETALLIC CRYSTALS. Jack Kingsley. June 1960. 128p. Contract AF49(638)-529.

A variety of experiments was performed with the object of understanding certain color center phenomena so as to shed light on the nature of the defects in the alkali halides and the mechanism of their formation and destruction. These experiments were directed toward the photoconductive, bleaching and restoration of properties of the V_4 center and toward a study of the details of the process involving the destruction of V_1 centers. The majority of the experiments were performed on potassium bromide. (auth)

20704 BLG-47
Brussels. Centre d'Étude de l'Énergie Nucléaire and Montreal. Univ.
FABRICATION ET ETUDE DES PROPRIETES DES EMULSIONS INOGRAPHIQUES. (Preparation and Study of the Properties of Ionographic Emulsions). J. Fournaux, J. Demers, and P. Demers. Mar. 23, 1960. 53p.

Systematic attempts were made to prepare nuclear emulsions according to P. Demers' formulas: double-cast precipitations, addition of a single halide, regular stirring, and 82% silver bromide in a dry emulsion. Several tables are presented showing clouding, grain size, and grain density along tracks of alpha particles, protons, and slow and relativistic electrons as a function of several factors including chemical equivalence, presence of chlorides, dilution, stirring and flow velocities, use of triethanolamine, development temperature and time, ripening, preservation, pouring, and drying. Detailed formulas are given. Plates and supportless emulsions were prepared. Emulsions showing long electron tracks with 25 to 45 grains per 100 μ were made in a reproducible manner. Fission fragment tracks were obtained with even more detail than in Demers' and Mathieu's emulsions. Frequently, one could recognize the origin of both opposed tracks by the discontinuity of their aspect. The undeveloped grains had a diameter of about 0.1 μ. The conclusions confirmed Perfilov's point of view that a very accurate equivalence was necessary during the precipitation. Comparative results suggested the necessity of obtaining uniform crystals with as few defects as possible. (auth)

20705 CEA-1378
France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay.
CONSTRUCTION D'UNE ENCEINTE POUR LA MANIPULATION D'UN KILOCURIE D'EMETTEURS GAMMA. (Building of a Facility for the Handling of Kilocurie Amounts of Gamma Emitters). Ph. Germond. 1960. 12p.

A hot cell designed to handle up to 1,000 curies of cobalt-

60 has been built in a preexisting shielded room, in order to make optimum use of available space. Heavy containers can be rolled in or out of the cell. Handling is performed with two manipulators designed and made by French manufacturers. One of them is pneumatically operated and the other one is mechanical. The general shape of the facility is that of an L. (auth)

20706 HW-63576

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959. Jan. 20, 1960. 76p. Contract AT(45-1)-1350. OTS.

Eleven papers are presented on theoretical reactor physics and computer programming, experimental reactor physics, and physics of nuclear safety. Separate abstracts were prepared for the eleven papers. (For preceding period see HW-62727.) (W.D.M.)

20707 LAMS-2385

Los Alamos Scientific Lab., N. Mex.

FIELD EMISSION OF ELECTRONS. A Bibliography of Abstracts. Helen Hanson and Gretchen Riese. Nov. 30, 1959. 113p. Contract W-7405-eng-36. OTS.

A bibliography is presented on electron emission. The quantity and techniques of both direct current fields and radio-frequency fields are included. The period covered is from the first observation of the phenomenon in 1897 to the present. (auth)

20708 LAMS-2447

Los Alamos Scientific Lab., N. Mex.

QUARTERLY STATUS REPORT OF THE LASL PLASMA THERMOCOUPLE DEVELOPMENT PROGRAM FOR PERIOD ENDING JUNE 20, 1960. Samuel Glasstone, comp. and ed. July 1960. 11p. Contract W-7405-eng-36. OTS.

Developments are summarized in terms of plasma cell oscillations, "in-pile" test programs, heat transfer mock-up, spectroscopic examination of a plasma cell, emissivity measurements, and materials problems. (For preceding period see LAMS-2423.) (W.D.M.)

20709 NYO-9084

New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center.

CONICAL REFRACTIONS IN CRYSTAL OPTICS AND HYDROMAGNETICS. Donald Ludwig. Apr. 22, 1960. 23p. Contract AT(30-1)-1480. OTS.

It is shown that the amplitude of the refracted wave, in the case of conical refraction, is governed by a hyberbolic partial differential equation within the phase surfaces of the refracted wave. The ray conoid of the partial differential equation is shown to be identical with the cone of refracted rays emanating from a point. The validity of the above statement is demonstrated for the cases of propagation of light incident on a biaxial crystal in the direction of an optic axis and propagation of a small hydromagnetic discontinuity across a plane normal to the magnetic field, in the case where the Alfven and sound speeds are equal. (C.J.G.)

20710 ORNL-2154(Rev.)

Oak Ridge National Lab., Tenn.

A SURVEY OF PLUTONIUM SPECTRUM DATA. J. R. McNally, Jr. Aug. 10, 1960. 216p. Contract W-7405-eng-26. OTS.

Various data on the spectra of plutonium compiled into a single tabulation are presented. A total of 9865 lines are listed covering the wavelength range from 24, 964 A to 2426 A. The information presented includes arc, spark, hollow cathode, and furnace intensities and references to hyperfine structure and isotope shift data. The present compilation supercedes that contained in ORNL-2154. (auth)

20711 WADC-TR-58-577

Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

PRELIMINARY SURVEY OF HIGH-SPEED IMPACT INFORMATION. Period covered: April to September 1958. Peter A. Franken, et al. Oct. 1958. 28p. Project No. 7360. Contract AF33(616)-5730. (AD-216029). OTS.

Studies on the high-speed impact of a simply shaped pellet (cylindrical or spherical) with a semi-infinite target are reviewed. The pellet and target are assumed to be composed of homogeneous materials. The experimental capabilities of conventional guns, rockets, and shock tubes for obtaining high-velocity particles are compared. Characteristic advantages and disadvantages associated with each propulsion system are outlined. A critical review of various approaches of utilizing models for analyzing experimental data on high-speed impact behavior is presented. The physical parameters used in describing high-speed impact phenomena are considered and problems of scaling by appropriate non-dimensional quantities are discussed. (C.J.G.)

20712 WAPD-MRJ-10

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

REACTOR PHYSICS AND MATHEMATICS TECHNICAL PROGRESS REPORT FOR THE PERIOD MARCH 1, 1960 TO JUNE 1, 1960. 128p. Contract AT-11-1-GEN-14. OTS.

Reactor Physics Experiments: Measurement was started of the fission rate of Pu^{240} relative to Pu^{239} and Pu^{241} in a series of 1.3% slightly enriched TRX lattices. Measurements of the lattice interaction effect on resonance capture in U^{238} were extended to include the case of low density UO_2 rods. Measurements were made of the neutron decay constants of a highly enriched U-Zr clean slab subcritical assembly using a pulsed neutron source. Measurements were made of the diffusion length of thermal neutrons in water at 166 and 244°C. Criticality and activation distribution measurements were initiated on a highly enriched Ur-Zr clean critical slab in the High Temperature Test Facility. Reactor Theory and Design Methods: The few-group thermal neutron model was extended to treat thin, highly absorbing regions. A study was initiated of the correlation of measurements of resonance integrals for various sized lumps in various moderators. Work was continued on two aspects of the two-dimensional treatment of lumped absorbers: (1) An improved method of calculating the P-3 approximation in cylindrical geometry was developed. (2) Effort was continued to develop a simple method, analogous to blackness theory, of applying transport corrections to two-dimensional lumped absorbers of arbitrary shape. The development is continuing of an accurate method of calculating resonance capture in heterogeneous slab configurations which would be practicable in nuclear design. The extension of the double P-1 approach to two-dimensional (x-y) geometry was initiated. An exploratory computer program was completed to solve the few-group fast, few-group thermal approximation to the energy transport equation in slab geometry. A P-3 approximation is used in the epithermal range and a double P-1 in the thermal groups. An exploratory digital program is being written to study various treatments of time steps in depletion codes. Reactor Kinetics and Control: An analog

method for computing self-shutdown during prompt critical excursions was applied to study the relative importance of the various shutdown mechanisms. It was determined that fuel plate expansion has a significant effect on shutdown. Theoretical predictions of self-sustained power oscillations under boiling conditions were confirmed by comparison with experiment. Two codes are being developed for the direct calculation in slab geometry of several types of modes of interest to space-time kinetics. The theoretical prediction of the background neutron source level was compared with measurements in a highly enriched Ur-Zr critical assembly. The measured value was 30% less than the theoretical prediction. Techniques were developed for the calculation of neutron importance in multi-dimensional geometry for application to the sourceless startup problem. The measured thermal neutron flux distribution in the water reflector of a clean slab critical was compared with theory and excellent agreement obtained. The distribution of capture gamma-ray spectra was reduced to two effective energy groups for application to shield design. Gamma-ray buildup factors were calculated for laminated shields in lead-water and iron-water. Mathematics and Digital Computation: Several methods of variance reduction for application to the Monte Carlo calculation of two-dimensional cell problems were studied. A digital program was formulated to study numerical methods of analysis for application to the hydrodynamics of a boiling reactor channel. Numerical methods of handling various types of rotational symmetry in the few-group multidimensional diffusion programs were developed. The Philco-2000 was installed and the nuclear design programs, PDQ-4, MUFT, KATE, WANDA, CANDLE, and ZIP, are being successfully run on a production basis. It is anticipated that the remaining major nuclear and thermal programs will be transferred to the Philco-2000 during the next period. A summary of the content of the new programs and their status is presented. (For preceding period see WAPD-MRJ-9.) (auth)

20713 AEC-tr-4129

RECOMBINATION AND "MINUS" CONTINUUM OF OXYGEN ATOMS. (Rekombinations- und "Minus"-Kontinuum der Sauerstoffatome). G. Boldt. Translated for Oak Ridge National Lab. from Z. Physik 154, 319-29(1959). 26p. (Includes original, 10p.). JCL.

The continuum emitted from a wall-stabilized electric arc burning in oxygen is measured in the wavelength range of 4300 to 6300 A for temperatures between 10,500 and 13,000°K. After subtraction of the mathematically determined free-free continuum of the electrons in the field of positive ions, a continuum remains which is composed of the recombination and the "minus" spectrum of the atoms (where the "minus" spectrum denotes the sum of the free-free continuum of electrons in the field of neutral atoms and the electron-affinity continuum of the atoms). It is possible to separate the two portions from each other. The absorption coefficients of the recombination continuum and the "minus" continuum are calculated relative to one atom and a single, negatively charged ion per cm^3. In the cited wavelength and temperature range, the coefficient of the "minus" continuum was greater by a factor of 10^4 to 10^5 than that of the recombination continuum. The intensities of the two emission continua in the plasma under investigation (pure oxygen, total pressure 1 atm) were of the same order of magnitude. It is stated that the "minus" continuum can be predominantly interpreted as the electron-affinity continuum. (auth)

20714 CEA-tr-R-790

MÉTHODE DE DÉTERMINATION DE LA MASSE ET DE L'ENERGIE DES PARTICULES À L'AIDE D'EMULSIONS NUCLEAIRES. II. (Method of Determining Mass and Energy of Particles using Nuclear Emulsions). [Part] II. M. Petrashku and K. Beshliu. Translated into French from Acad. rép. populaire Roumaine, Rev. phys. 2, 229-32(1957). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 4841.

20715 CEA-tr-R-796

CORRECTION DE L'AUTO-ABSORPTION DES PARTICULES α DANS LA MESURE DE L'ACTIVITE D'ECHANTILLONS PLATS. (Correction for Alpha-Particle Self-Absorption in Measuring the Activity of Flat Samples.). D. P. Osanov and V. I. Popov. Translated into French from Pribory i Tekh. Ekspt. No. 5, 32-4(1958). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 2821.

20716 CEA-tr-R-807

MESURE PHOTOMÉTRIQUES DES TRACES DE PARTICULES CHARGÉES DANS LES ÉMULSIONS PHOTOGRAPHIQUES. (Photometric Measurement of Charged Particle Tracks in Photographic Emulsions). B. A. Voikovskiĭ (Voikovsky), A. I. Galaktionov, M. I. Tret'yakova (Tretiakova), and A. E. Chudakov (Tchoudakov). Translated into French by [I.] Melnick from Pribory i Tekh. Ekspt. No. 6, 38-41(1957). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 14094.

20717 JPRS-2854

CALCULATION OF THE COHESIVE ENERGY OF METALS BY THE FERMI-THOMAS METHOD. K'ai-chia Ch'eng. Translated from Wu Li Hsueh Pao 14, 106-12(1958). 14p. OTS.

The Fermi-Thomas method is used to calculate the cohesive energy of metals. The preliminary results obtained indicate that there is a minimum value involved in the relation between the energy and the crystal lattice constant of a metal. For heavy metals, the atomic spacings corresponding to this minimum value are shown to be close to the experimental values; however, for univalent alkali metals, the theoretical values are too small, and the cohesive energies so obtained are much larger than the experimental values. Such discrepancies are due to errors typical in an application of the Fermi-Thomas method to atoms, and they are not particularly pertinent to the application to metals. (auth)

20718

EXPERIMENTAL STUDIES ON THE LUMINESCENCE OF CADMIUM IODIDE ACTIVATED BY LEAD. Chung-tu Nguyen (Université, Rennes, France). Ann. phys. (13) 5, 567-613(1960) May-June. (In French)

In the study of the luminescence of CdI_2(Pb), it is necessary first to determine the methods of preparation. The study of the solubility of lead iodide in aqueous solutions of cadmium iodide at different concentrations and different temperatures has permitted the preparation of homogeneous powders of the two iodides in definite proportions. In an investigation of the effect of the lead concentration on the luminescence, it was shown that low concentrations affect the luminescence in two distinct fashions, according to whether the quantity of lead is more or less than 10^{-3}. Increased temperature causes the attenuation of the luminescence and the displacement and broadening of the spectrum. (J.S.R.)

20719

DETERMINATION OF THE BACKGROUND NOISES BY MEANS OF THE CROSSED PRODUCTS OF THE SECOND DIFFERENCE IN THE DEFLECTION METHOD, PERMITTING THE EVALUATION OF MULTIPLE SCATTERING. Brigitte Dépaux, Simone Desprez-Rebaud, and Tsai-Chü. Compt. rend. 250, 4343-5(1960) June 27. (In French)

The background noise from the emulsion itself appears in crossed products. It increases less swiftly with the length of the cell than in the mean quadratic value of the second differences D_i^2. The square of the background noise can itself come into play in $\overline{D_i D_{i+1}}$ and $\overline{D_i D_{i+2}}$ with a negative coefficient. (tr-auth)

20720

EVALUATION OF THE PRESSURE OF THE INITIATOR SHOCK OF A DETONATION. Claude Fauquignon. Compt. rend. 251, 38-40(1960) July 4. (In French)

In the processes of detonation initiation by shock, the characteristics of the shock vary continuously in the preinitiation zone. A method is developed to evaluate the pressure in this zone. (tr-auth)

20721

COMPARATIVE STUDY OF THE SENSITIVITY OF IONOGRAPHIC EMULSIONS BETWEEN +20 AND −196°C WITH RESPECT TO LIGHT RADIATION AND α RADIATION FROM POLONIUM. Monique Debeauvais-Wack. Compt. rend. 251, 76-8(1960) July 4. (In French)

The variation of the sensitivity of Ilford ionographic emulsions G_8 and C_2 exposed to α radiation and to light photons at temperatures between +20 and −196°C was studied. The results found can be interpreted according to the Cüer hypotheses on the surface dispersion of latent image grains and permits the anticipation of discrimination between particles of different energies. (tr-auth)

20722

HIGH ENERGY PHYSICS. P. Preiswerk (European Organization for Nuclear Research, Geneva). Experientia 16, 222-8(1960). (In German)

A brief review is given of the actual state of high-energy physics with a discussion of cosmic-ray research, accelerators for high-energy particles, instruments for detection of fast particles, and classification of elementary particles. (auth)

20723

THE RESULTS OF AN EXPERIMENTAL INVESTIGATION OF THERMOELECTROMOTIVE FORCE IN THERMISTORS. A. P. Pereleshina (Krzhizhanovskii Inst. of Power Engineering, Moscow). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 3, No. 4, 119-22(1960) Apr. (In Russian)

Results are given of an experimental investigation of the thermal and electrical properties of disc thermistors made respectively from: AgCl, CuO, Ag_2S, Mn_2O_3, and MnO. Results obtained lead to the conclusion that it is possible to use these thermistors for the measurement of heat flow. A theoretical explanation is given of the relationships obtained. (auth)

20724

PERFORMANCE OF A THERMOELECTRIC CONVERTER UNDER CONSTANT HEAT FLUX OPERATION. P. S. Castro and W. W. Happ (Lockheed Missiles and Space Div., Palo Alto, Calif.). J. Appl. Phys. 31, 1314-17(1960) Aug.

The performance characteristics of a conventional thermoelectric generator operating under constant heat flux conditions were computed. Expressions for power output, optimum efficiency, and optimum ratio of internal-to-load resistance show that optimization requires operating conditions appreciably different from those for the operation of thermoelectric generators having constant hot and cold junction temperatures. Performance curves are presented for the optimum ratio of internal-to-load resistance when either the internal resistance or the load resistance is under the control of the designer. (auth)

20725

THREE-DIMENSIONAL SPACE CHARGE FLOW. Jorge Rosenblatt (Comisión Nacional de Energía Atómica, Buenos Aires). J. Appl. Phys. 31, 1371-7(1960) Aug.

The general theory of stationary beams of prescribed shape is developed taking into account the electrostatic interaction between the particles. The Hamilton-Jacobi equation, expressed in a particular system of coordinates, allows the determination of the potential distribution inside the beam. Compatibility conditions for the equations are obtained, as well as a general rule for the determination of the feasibility of arbitrarily chosen trajectories. A theoretical expression results for the proportionality coefficient k in Child's law ($J = kV^{3/2}$) which relates current density J with the potential difference V between electrodes. The theory was applied to the particular case of a plane beam with hyperbolic boundaries. The beam was experimentally reproduced, providing values for k in close agreement with the theoretical ones. (auth)

20726

CONTRIBUTION OF ANODE EMISSION TO SPACE CHARGE IN THERMIONIC POWER CONVERTERS. Anthony F. Dugan (Lockheed Missiles and Space Div., Sunnyvale, Calif.). J. Appl. Phys. 31, 1397-1400(1960) Aug.

The space charge theory of Langmuir was extended to include the effects of anode emission on the performance of a vacuum thermionic power converter. The basic equation is similar to Langmuir's $\xi-\eta$ equation, but it involves two additional parameters which depend on the temperatures and thermionic properties of the electrodes. An iterative technique is described for obtaining solutions in specific cases, and some sample calculations based on hypothetical diodes are presented. The calculations indicate that the effect of the anode temperature is considerably more pronounced if the cathode-anode work function difference is large. (auth)

20727

CHARACTERISTIC ENERGY LOSSES OF ELECTRONS IN CARBON. Lewis B. Leder and J. A. Suddeth (National Bureau of Standards, Washington, D. C.). J. Appl. Phys. 31, 1422-6(1960) Aug.

The values reported for the characteristic energy losses of electrons in carbon vary by as much as 50%. In an attempt to resolve this discrepancy the electron energy losses were remeasured for evaporated carbon and natural graphite, and it was found that there is a large difference for these two forms of carbon. Electron diffraction patterns of evaporated carbon show it to be highly amorphous. Annealing of the films causes growth of the crystallites, and also an increase of the energy loss toward the loss values for graphite. It is shown by calculation that the difference in the energy losses for the two forms is due to a difference in density, and that annealing increases the density of the evaporated carbon and, therefore, the energy loss value. (auth)

20728

SIMPLE THEORY CONCERNING THE REFLECTION OF ELECTRONS FROM SOLIDS. T. E. Everhart (Univ. of Cambridge, Eng.). J. Appl. Phys. 31, 1483-90(1960) Aug.

A simple theory concerning the reflection of electrons from targets is derived, based on the following assumptions: (1) the primary cause of electron reflection from a solid material is Rutherford scattering through angles greater than 90°; (2) the energy loss of electrons penetrating a solid target is given by the Thomson-Whiddington law, or a modified version of it; (3) no multiple scatterihg is allowed. An expression for the reflection coefficient r is derived that agrees surprisingly well with experimental data, in view of the above simplifying assumptions. In particular, the correct variation of r with atomic number Z is obtained, and the observed value of the fractional escape energy is calculated in the limit as $Z \rightarrow 0$, where the theory is most accurate. A critical discussion of the simplifying assumptions is given, and the range of validity of the theory is estimated. This theory leads to a better understanding of the related phenomena of secondary emission at primary electron energies between 2 and 50 kev. (auth)

20729

ANOMALOUS THERMIONIC EMISSION FROM UC AND $(ZrC)_{0.8}(UC)_{0.2}$. G. C. Kuczynski (Univ. of Notre Dame, Ind.). J. Appl. Phys. 31, 1500-1(1960) Aug.

Thermionic emission from UC and $(ZrC)_{0.8}(UC)_{0.2}$ was investigated. The results obtained by Pidd et al. were plotted. The points representing emission current density for ZrC were reasonably approximated by one straight line, but the points obtained for UC and $(ZrC)_{0.8}(UC)_{0.2}$ were best fitted by two straight lines, separated by an interval of temperatures in which a rather sharp increase in current density took place. In this interpretation the anomaly completely disappeared. (M.C.G.)

20730

GENERATION OF ALTERNATING CURRENT IN THE CESIUM CELL. H. L. Garvin, W. B. Teutsch, and R. W. Pidd (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Appl. Phys. 31, 1508-9(1960) Aug.

The cesium cell was found to generate alternating current in significant amounts under certain conditions. The a-c appeared to be related to intriensic phenomena occurring within the cell, and it was only slightly affected by the nature of the external circuit. The generation of alternating current occurred over a wide range of variables. The appearance of the waveforms depended on the d-c terminal potential difference. An instability appeared to exist in the plasma region between the cell electrodes such that the electronic current was automatically interrupted. (M.C.G.)

20731

(Zn,Hg)S AND (Zn,Cd,Hg)S ELECTROLUMINESCENT PHOSPHORS. A. Wachtel (Westinghouse Electric Corp., Bloomfield, N. J.). J. Electrochem. Soc. 107, 682-8(1960) Aug.

Solid solutions of (Zn,Hg)S prepared by firing in sealed silica tubes are cubic in structure. With suitable additions of Cu and a coactivator, photoluminescence and electroluminescence are obtained. The coactivators used were halides, Ga, or In. The electroluminescence in the red consists of two emission bands which do not appear to be analogous to the blue and green emission bands of Cu, Cl in ZnS. The quantum efficiency is of the same order of magnitude as that of ZnS:Cu, Cl, but the emission bandwidth is about twice as large and the red electroluminescence consists of emission located to a large extent in the infrared. HgS tends to retain the cubic structure of ternary (Zn, Cd, Hg)S systems provided that the Cd/Hg ratio does not exceed certain limits; until this is so, the introduction of Cd causes increased electroluminescence. (auth)

20732

HARMONICS FROM A MICROWAVE GAS DISCHARGE. N. R. Bierrum and D. Walsh (Oxford Univ.). J. Electronics and Control (1), 8, 81-90(1960) Feb. (In English)

Harmonic power from a 10-cm wavelength glow discharge in neon was detected down to 6-mm wavelength (16th harmonic). The fundamental power is fed from the waveguide to a coaxial line terminated by the discharge tube. A second smaller waveguide is coupled to the coaxial line to extract the harmonic power. With careful matching at each wavelength, the conversion loss appears to fall off by only 3 to 4 db per harmonic after an initial drop of 35 db to the third harmonic (lowest harmonic measured). A typical conversion loss from 10 cm to 8 mm (12th harmonic) is 63 db, e.g., 20 kw input, 10 mw output. In general the output power increases with input power until arcing in the mount spoils the measurement. A pressure range of 5 to 39 mm Hg was used. (auth)

20733

CROSS SECTIONS FOR IONIZATION OF THE INERT GASES BY ELECTRON IMPACT. B. A. Tozer and J. D. Craggs (Univ. of Liverpool). J. Electronics and Control (1) 8, 103-9(1960) Feb. (In English)

Measurements of the total cross sections for ionization of the rare gases argon, krypton, and xenon under electron impact over the electron energy range up to 100 ev were made with a Lozier apparatus. Measurements in argon show close agreement with those of Tate and Smith except in the low energy region below about 25 ev. (auth)

20734

COLLOQUE SUR LA PHYSIQUE NUCLÉAIRE AUX BASSES ET MOYENNES ÉNERGIES, COMMUNICATIONS PRESENTEES A GRENOBLE, LES 29 FÉVRIER, 1er ET 2 MARS 1960. (Colloquium on Nuclear Physics at Low and Middle Energies, Held at Grenoble, February 29, March 1 and 2, 1960). J. phys. radium 21, 265-504(1960) May. (In French)

Papers presented at the Colloquium on Nuclear Physics at Low and Middle Energies at l'Université de Grenoble, Feb. 29, March 1 and 2, 1960, are given. The meeting was organized by the Section de Physique Corpusculaire of the Societe Francaise de Physique with the help of l'Universite de Grenoble. Separate abstracts have been prepared for each of 75 papers presented. (T.R.H.)

20735

EXPERIMENTS WITH 2-Mev LITHIUM IONS. S. M. Shafroth (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 353-4(1960) May. (In French)

The 2-Mev Van de Graaff at Saclay has been adapted for lithium ion acceleration. $Li^6 + C^{12}$ and $Li^7 + C^{12}$ have been studied using nuclear plates in a scattering chamber. Measurements of differential cross sections and angular distributions are given. (auth)

20736

PREPARATION OF THIN SOURCES OF S^{35} AND STUDY AT VERY LOW ENERGIES. A. Juillard (Institut de Physique Nucléaire, Lyon). J. phys. radium 21, 467-9(1960) May. (In French)

Techniques are described for obtaining very thin S^{35} sources of good specific activity and stable in vacuum. The low energy β spectrum permits one to determine transmission curves of counter windows and preacceleration corrections. Comparative study of various sources give indications on the deformation of the spectrum. (auth)

20737

EFFECT OF TRANSVERSE MAGNETIC FIELD ON THE FLOW DUE TO AN OSCILLATING FLAT PLATE. [PART]

II. Tsunehiko Kakutani (Kyoto Univ.). J. Phys. Soc. Japan 15, 1316-31(1960) July. (In English)

The hydromagnetic flow of an electrically conducting fluid due to an oscillating flat plate of perfect conductor in the presence of transverse magnetic field was investigated. Exact solutions for arbitrary values of R (the Reynolds number), R_m (the magnetic Reynolds number) and S (the magnetic pressure number) are first derived and then some special cases are discussed corresponding to limiting values of the parameters S and R_m in order to clarify the hydromagnetic effect, and especially an interesting special case corresponding to the 'magnetic Stokes approximation' is discussed in some detail. Drag on the plate is calculated for both cases of non-conducting plate and perfectly conducting plate. It is found that, in both cases, the amplitudes of the total drag (shear-stress + Maxwell's stress) always increase and the initial phases of the total drag are always retarded for any values of R, R_m and S compared with those of the well-known classical case, i.e., the case of no magnetic field and/or the electrical conductivity of the fluid being zero. (auth)

20738

FERRIMAGNETIC RESONANCE IN A SINGLE CRYSTAL OF EUROPIUM–IRON GARNET. Tomonao Miyadai, Hisao Takata, and Yūzō Shichijō (Nippon Telegraph and Telephone Public Corp., Tokyo) and Noboru Tsuya (Tohoku Univ., Sendai). J. Phys. Soc. Japan 15, 1354 (1960) July. (In English)

Ferrimagnetic resonance was studied in a single crystal of europium–iron garnet in the temperature range between liquid nitrogen and the Curie point. It was found that g-values for the single crystal were slightly smaller than those for polycrystalline samples and showed a somewhat stronger temperature dependence. K_1/M_s of europium–iron garnet was negative. The line width increased with increasing temperature at low temperatures, passed through a maximum, then decreased, and finally increased rapidly just below Curie temperature as was predicted by theory. (M.C.G.)

20739

FLUORESCENCE SPECTRA OF COORDINATED HOLMIUM AND THULIUM IONS. G. A. Crosby and R. E. Whan (Univ. of New Mexico, Albuquerque). Naturwissenschaften 47, 276-7(1960). (In German)

The emission spectra of trivalent thulium and holmium ions observed in a reproducible oxygen coordination sphere are reported. The prominant lines from the ultraviolet radiation of chelates are tabulated. The chelates were irradiated while dissolved in a rigid hydrocarbon matrix at a concentration of 10^{-5} M at 77°K. The line emissions observed from Ho(benzoylacetonate)$_3$ and Ho(dibenzoylmethide)$_3$ show a considerable variation of line pattern. No line emission could be obtained for Tm(dibenzoylmethide)$_3$. (J.S.R.)

20740

NUCLEAR HYPERFINE STRUCTURE IN THE ABSORPTION SPECTRUM OF A CRYSTALLINE SALT. I. Grohmann, K. H. Hellwege, and H. G. Kahle (Technische Hochschule, Darmstadt, Ger.). Naturwissenschaften 47, 277-8(1960). (In German)

In the visible absorption spectrum of Ho^{3+} in crystalline holmium ethyl sulfate at 4.2°K, one observes a whole series of lines which have a box-like line form with steeply decreasing sides. Such a line, resolved easily into eight components by a magnetic field parallel to the crystal axis, is shown. It corresponds to a transition from the lowest crystal field component I with the crystal quantum number $\bar{\mu} = \pm 1$ of the ground term $^5I_8$ to a component with $\bar{\mu} = \pm 2$ in an excited term, probably $^3K_8$. From the measurements made at 4.2°K and after correction of the magnetic dipole-dipole interaction between the holmium ions, $g_{\parallel} = 15.48 \pm 0.10$ for the lowest ground term component with $\bar{\mu} = \pm 1$. For the component with $\bar{\mu} = \pm 2$ in the excited term $g_{\parallel} = 15.68 \pm 0.20$. (J.S.R.)

20741

A THEORY ON OBTAINING SHORT BURSTS OF IONS FROM A BEAM OF IONS. T. K. Fowler and W. M. Good (Oak Ridge National Lab., Tenn.). Nuclear Instr. & Methods 7, 245-52(1960) June. (In English)

The problem of producing bursts of ions by beam sweeping across an aperture was studied. By considering several examples of electric-field sweeping, it is shown that (a) an essential equivalence exists between different time-varying wave forms that may be employed, (b) that the beam quality, as measured by energy and/or angular spread, is necessarily diminished in the process of burst production. In a general way it is shown that if a steady "monoenergetic" beam, characterized by y-component of momentum spread Δp_y and object size Δy, is chopped by beam sweeping, then there is a relation which in its simplest form is given by $\Delta E \Delta t = \Delta p_y \Delta y$. In this relation ΔE is the energy that must be introduced into a monoenergetic beam in order to produce bursts as short as Δt. Finally, it is shown that beam bunching results in diminished beam quality. An example is klystron bunching of a nearly parallel pulsed beam. In this case there is a relation, the simplest form of which is $\Delta E_a \Delta t_a = \Delta E_b \Delta t_b$ relating the product $\Delta E \Delta t$ before bunching to that which exists after bunching. (auth)

20742

ON A CONVERGENT NON-LOCAL FIELD THEORY. [PART] I. E. Arnous (Centre National de Recherche Scientifique, Paris) W. Heitler (Universität, Zurich) and Y. Takahashi (Dublin Inst. for Advanced Studies). Nuovo cimento (10) 16, 671-82(1960) May 16. (In English)

A nonlocal field theory is developed and formulated in interaction representation with the view of obtaining a converging theory. At least one special type of form factor is known for which this theory converges throughout, but the form factor is not specified (it may even be a q-number). The view is taken that convergence should take precedense over exact Lorentz-invariance, because present knowledge does not necessarily exclude a violation of Lorentz-invariance inside the source. It is shown that the total charge is the same as in local theory and is conserved, provided only that the form factor commutes with the field operators. The invariance against groups of transformations is discussed in a general way and for the special case of Lorentz-transformations. It is shown that the Schroedinger equation can always be formulated in an invariant manner, but that this does not imply the invariance of the S-matrix. The conditions for the invariance of the S-matrix are derived. The theory contains the local theory as a special case. (auth)

20743

COMPTON EFFECT ON THE BOUND ELECTRONS. D. Brini, E. Fuschini, N. T. Grimellini, and D. S. R. Murty (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10) 16, 727-36(1960) May 16. (In English)

The behavior of the Compton differential cross section on the K electrons of Pb was measured, using γ rays of 664 kev energy. The investigated angles cover the 10 to 85° range. The behavior is roughly not very different from the

behavior corresponding to free electrons. The more significant aspect is the indication of a cross section for the bound electrons greater than the cross section for free electrons. (auth)

20744

NEW MEASUREMENTS OF THE SPIN-LATTICE RELAXATION TIME IN LIQUID HELIUM 3. G. Careri, I. Modena, and M. Santini (Università, Padua). Nuovo cimento (10) 16, 782-3(1960) May 16. (In English)

Measurements of the spin-lattice relaxation time T_1 in liquid helium-3 were repeated for the purpose of checking data discrepancies. Those made with a 3-mm ID pyrex cell confirmed the sharp rise found by the authors around 1.5°K, but those made with 6- and 10-mm ID cells are flat and closer to those by Garwin and Reich, while the 10-mm ID cell purged with H_2 at 150°C gave data close to those of Romer. It is concluded that T_1 measurements in a glass cell are subject to wall effects with absorbed O_2 acting as a catalyst, and that Romer's data are correct because he did not note any effect when he changed the size of his cell. It is emphasized, however, that the wall effects are not well understood; for example, the sharp rise noted by the authors cannot be explained in terms of the diffusion coefficient which does not show any sharp change at 1.5°K. (D.L.C.)

20745

NUCLEAR MAGNETIC RESONANCE IN LITHIUM AND DILUTE LITHIUM–MAGNESIUM ALLOYS. D. G. Hughes (National Research Council, Ottawa). Phil. Mag. (8) 5, 467-71(1960) May.

The Knight shift and line width of the Li^7 resonance in dilute Li–Mg alloys were investigated. The observed rapid fall in Knight shift with alloying concentration was interpreted using Drain's theory. Line-width measurements showed that the activation energy of self-diffusion of the Li^7 atoms increased from 13.1 ± 0.2 kcal/mole for pure lithium to 14.5 ± 0.3 kcal/mole for the 10 at.% magnesium alloy. (auth)

20746

THE K EMISSION SPECTRUM OF METALLIC LITHIUM. R. S. Crisp and S. E. Williams (Univ. of Western Australia, Nedlands). Phil. Mag. (8) 5, 525-7(1960) May.

The lithium K emission spectrum in the third order of a one-meter glass grating was recorded under improved vacuum conditions in which there was virtually no target contamination. An energy resolution of 0.07 ev was obtained. The spectrum showed a high-energy edge, characteristic of an unfilled band, which extended to 75% of the maximum intensity. The width of the edge, including the experimental window, was 0.30 ev. (M.C.G.)

20747

DIAMAGNETIC SHIELDING OF NUCLEI IN METALS. T. P. Das (Columbia Univ., New York) and E. H. Sondheimer (Queen Mary Coll., London). Phil. Mag. (8) 5, 529-31(1960) May.

In the study of diamagnetic shielding of nuclei in metals, it was found that conduction electrons may produce an appreciable diamagnetic shift due to their orbital motion in a magnetic field. The diamagnetic contribution to the nuclear resonance shift was calculated for the case of free electrons. (M.C.G.)

20748

EFFECT OF THE λ TRANSITION ON THE ATOMIC DISTRIBUTION IN LIQUID HELIUM BY NEUTRON DIFFRACTION. D. G. Henshaw (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. 119, 9-13(1960) July 1.

Neutron-diffraction patterns for samples of liquid helium at 1.06, 2.29, and 2.46°K were measured at 4 to 64° using 1.06 A neutrons. The liquid structure factor i(s) + 1 was deduced for each curve and these show a change which is associated with the λ transition which indicates that the spatial order in the liquid is smaller below the λ point than above. The measurements were transformed to give the radial distribution function $4\pi r^2[\rho(r)-\rho_0]$ from which was deduced the number of neighbors under the first shell of atoms and the nearest distance of approach of two atoms in the liquid. These lie between 8 atoms and 9 atoms and 2.35 and 2.40 A, respectively. (auth)

20749

PRESSURE EFFECT IN THE ATOMIC DISTRIBUTION IN LIQUID HELIUM BY NEUTRON DIFFRACTION. D. G. Henshaw (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. 119, 14-21(1960) July 1.

The angular distribution of 1.06 A neutrons scattered from liquid helium at temperatures and pressures at 1.2 to 4.24°K and 0 to 51.3 atmospheres for densities to 0.184 g/cc was measured at about 210 equally spaced points for angles of 5 to 62°. With increasing liquid density, the principle maximum moves to larger angles and increases in height. The liquid structure factors are given for densities of 0.166 g/cc and 0.184 g/cc. The density distribution functions are deduced for each of the scattering patterns. A study of these gives 2.27 ± 0.08 A as the nearest distance of approach of two atoms in the liquid. The number of neighbors under the first and second coordinate shells changes from about 6.5 to 8.5 atoms and from about 9 to 5.5 atoms, respectively, for density changes from 0.095 g/cc to 0.184 g/cc. The corresponding change in the ratio of their spacings is from 1.47 to 1.38, which values are close to $\sqrt{2}$, the theoretical ratio for a close packed lattice. The analysis shows that the density changes in the liquid and during the solid-liquid transformation cannot be accounted for on the basis of a uniform dilation of a basic structure. The changes in the distribution function caused by pressure are different from those caused by temperature along the normal vapor pressure line. (auth)

20750

STRUCTURE OF LIQUID OXYGEN BY NEUTRON DIFFRACTION. D. G. Henshaw (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. 119, 22-6(1960) July 1.

The angular distribution of 1.04 A neutrons scattered by specimens of liquid oxygen at 90.7, 69.0, 62.4, and 54.7°K was measured over the angular range 3 to 78°. Pronounced excess scattering at low angles is taken to be magnetic in origin and its form suggests the possible existence of short range magnetic order in the liquid. The measured distributions corrected for magnetic scattering were transformed to the radial distribution functions $4\pi r^2[\rho(r)-\rho_0]$. An analysis of these gives 1.2 atoms and 1.26 A as the number of neighbors in, and the spacing of the diatomic shell, 2.7 A as the nearest distance of approach of 2 atoms in adjacent molecules in the liquid, and about 3.9 A as the spacing of the main density maximum. The total number of atoms in the main density maximum increases from about 16 to 21 atoms for temperature change from 90.7 to 54.7°K. The possible existence of the O molecule is discussed. (auth)

20751

POSSIBLE PHASE TRANSITION IN LIQUID He^3. V. J. Emery and A. M. Sessler (Univ. of California, Berkeley). Phys. Rev. 119, 43-9(1960) July 1.

A possible phase transition in liquid He^3 was investigated theoretically by generalizing the Bardeen, Cooper, and Schrieffer equations for the transition temperature in the

manner suggested by Cooper, Mills, and Sessler. The equations are transformed into a form suitable for numerical solution and an expression is given for the transition temperature at which liquid He^3 will change to a highly correlated phase. Following a suggestion of Mottelson, it is shown that the phase transition is a consequence of the interaction of particles in relative D states. The predicted value of the transition temperature depends on the assumed form of the effective single-particle potential and the interaction between He^3 atoms. The most important aspects of the single-particle potential are related to the thermodynamic properties of the liquid just above the transition temperature. Two choices of the two-particle interaction, consistent with experiments, yield a second-order transition at a temperature between approximately 0.05 and 0.1°K. The highly correlated phase should exhibit enhanced fluidity. (auth)

20752

ANGULAR DISTRIBUTION OF SECONDARY ELECTRONS FROM (100) FACES OF COPPER AND NICKEL. Jay Burns (Univ. of Chicago). Phys. Rev. 119, 102-14(1960) July 1.

The angular distributions of secondary electrons from (0 0 1) faces of copper and nickel single crystals were measured for secondaries in four energy ranges (0 to 10, 10 to 20, 20 to 40, and 40 to 90 ev) for primary electron energies of 250, 500, and 800 ev. Fine structure was observed which consisted of weak peaks in the angular distribution superimposed on a background having approximately a cosine distribution. After making corrections for the refraction of secondaries at the surface of the crystal, the internal angular distribution peaks fall along principal low-index directions in the crystal as suggested in the quantum-mechanical collision theories of Wooldridge and of Dekker and van der Ziel. The positions, intensities, and widths of the peaks cannot be accounted for in terms of diffraction of the internal secondaries. The observed peaks are believed to be secondaries produced in the initial collision between the primary electron and a lattice electron of the crystal, enough of these secondaries having escaped the crystal without further collisions to make their observation possible. Details of the angular distribution are in agreement with collision theory based on a screened Coulomb interaction with a velocity-dependent screening length. The velocity dependence of the screening coefficient in the screened Coulomb interaction leads to a sharp drop in the inelastic cross section for energy transfers larger than the plasma excitation energy, and it also leads to increased probability for collisions in which the primary suffers only small deflections. The role of the band structure of the crystal in determining the features of the collision is discussed. In Cu and Ni the vacuum level of potential lies in the second Brillouin zone, so only interzone (umklapp) transitions can lead to secondary electron emission from these metals. Surface refraction is treated in terms of a velocity-dependent refractive index, and the experiment offers a means of determining the velocity dependence of the index. Experimental procedures and precautions required to observe the angular distribution fine structure are discussed. (auth)

20753

MAGNETIC STRUCTURE OF Mn_4N. W. J. Takei and G. Shirane (Westinghouse Research Labs., Pittsburgh) and B. C. Frazer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 119, 122-6(1960) July 1.

The magnetic structure of Mn_4N was determined by neutron diffraction from powders. The cubic unit cell has Mn at the corner and face centers and N at the body center. Standard diffraction techniques led to four possible models and it was necessary to perform polarized neutron beam experiments to resolve this ambiguity. The structure is ferrimagnetic with a corner moment of $3.5\mu_B$ antiparallel to the three face center moments of $0.7\mu_B$. (auth)

20754

APPROXIMATE WAVE FUNCTIONS FOR ATOMIC Be. R. E. Watson (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 119, 170-7(1960) July 1.

A configuration interaction calculation, involving thirty-seven configurations and including the $(1s)^2(2s)^2$ Hartree-Fock function, was made for the ground state of atomic Be. Approximately 90% of the correlation energy was incorporated into the final total energy. The results indicate that the correlation energy is associated with two effects, namely that of the "correlation hole" as was observed for He and that of "orbital degeneracy" (which does not appear in the two-electron He case). The former effect is best handled by the Hylleraas approach and the latter by the configuration interaction method. The results suggest that an admixture of the two methods would lead to the most rapidly convergent description of the exact four-electron wave function. The errors introduced by handling "high-lying" configurations by second-order perturbation theory rather than by exact configuration interaction are investigated. (auth)

20755

APPROACH TO EQUILIBRIUM IN QUANTAL SYSTEMS: MAGNETIC RESONANCE. A. Sher and H. Primakoff (Washington Univ., St. Louis). Phys. Rev. 119, 178-207 (1960) July 1.

A derivation is presented of the "master" or Boltzmann "gain-loss" equation from the Schrödinger equation, i.e., a derivation of the equation for the evolution in time of the probabilities of finding a physical system in its various states from the equation for the corresponding probability amplitudes. The "master" equation is derived for an, in effect completely self-enclosed, "supersystem," [A + B], consisting of a "system of interest," [A], and a "surroundings," [B], in relatively weak mutual interaction. A discussion is given of the range of validity of the "master" equation for [A + B] and it is shown that the random phase assumption is required for the state vector of [A + B] at the initial time only. The normally microcanonical character of the equilibrium statistical configuration of [A + B] is demonstrated and a treatment is given of exceptional, "extremely quantal-coherent," initial statistical distributions of [A + B] which may evolve away from equilibrium. Derivations are presented of the "master" equation for [A] and of the "master" equation for an individual particle or quasi-particle [q], within [A]; a discussion of the range of validity of these "master" equations is given and the normally canonical character of the equilibrium statistical configuration of [A] is deduced. General solutions of the "master" equations for [A + B], [A], and [q] are worked out and the relation between the principles of "microscopic reversibility" and "detailed balance" and the nonoscillatory character of the approach to equilibrium are exhibited. A theorem is presented regarding the time variation of the entropy of [A]. As illustrations of the general methods developed two important processes in magnetic resonance—the time variation of the longitudinal magnetization, $(\mu)_t$, and the time variation of the transverse magnetization, $(\mu')_t$—are discussed. It is shown that the variation of $(\mu)_t$ with t and of $(\mu')_t$ with t for a "nonrigid" lattice can be described by means of the "master" equation for an individual spin [q] and several special cases are discussed on the

basis of the evaluation of the appropriate transition probabilities; a comparison with the "spin-temperature" procedure is appended. It is demonstrated that for a "rigid" lattice no description of the variation of $(\mu')_t$ with t can be given on the basis of a "master" equation; in this case, quantal coherence effects neglected in the derivation of the "master" equation from the Schrödinger equation are vital and $(\mu')_t$ must be evaluated by a rigorous calculation of Trace {[appropriate time dependent density matrix] μ'}. (auth)

20756

INTERACTION OF PHONONS AND SPIN WAVES IN YTTRIUM IRON GARNET. E. H. Turner (Bell Telephone Labs., Holmdel, N. J.). Phys. Rev. Letters 5, 100-1(1960) Aug. 1.

Magnetic studies were made on a 0.019-inch yttrium iron garnet sphere at 300°K in a microwave cavity in order to discover relations between the r-f field strength and the spin wave resonance. The results were plotted on a width of the spin wave resonance (ΔH_k) vs $\sqrt{H_m - H}$ graph, where H is the applied d-c field and H_m is the limiting H for $\frac{1}{2}\pi$-directed spin waves as the wave number k approaches zero. The two sharp peaks in H_k are ascribed to coupling of spin waves to phonons of the same frequency; the second peak's being larger than the first one indicates stronger coupling of higher k waves. The data is interpreted in terms of elastic constants and could be used to study the magneto-acoustic interaction. (D.L.C.)

20757

THERMAL PROPERTIES OF SOLID He^4. Louis Goldstein (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters 5, 104-5(1960) Aug. 1.

The question is explored whether the anomalous thermal properties of liquid He^4 will persist in the solid at or near the melting line. Solid He^4 is concluded to be completely anomalous over a limited range of the interval T_1-T_2 and (probably) over a pressure range above p, where T_1 and T_2 are the loci of the temperatures of vanishing isobaric volume expansion coefficients of phases I and II, respectively, and p is the melting pressure line. This result is in agreement with the conception that quantum effects persist over limited regions of the solid phases of the He isotopes. (D.L.C.)

20758

SELECTION RULES FOR INTERACTION TYPES IN QUANTUM FIELD THEORY. Shoji Ozaki (Kyushu Univ., Fukuoka). Progr. Theoret. Phys. (Kyoto) 23, 221-8(1960) Feb. (In English)

The Dirac equation is generalized to the form involving the γ_5 term, which is reduced to the Klein-Gordon equation when it is iterated. Such a generalized quantum electrodynamics is proved to be equivalent to the usual quantum electrodynamics only with the usual vector coupling. If the principle is adopted that the fermion must obey the generalized Dirac equation and that the equation including interaction is invariant under the similarity transformation by which it is reduced to the original Dirac equation, it is prohibited to introduce the Pauli term into quantum electrodynamics because the term in the generalized Dirac equation violates the parity inversion and time reversal invariance. It is also found that only the interaction terms of types A and V are selected in the universal Fermi-interaction and in the case of hyperonic decays into a nucleon and a π meson only the interaction types A and V are allowed by using the principle mentioned above, but in these cases the parity inversion and particle-antiparticle conjugation invariance do not hold. If the invariance under P, T, and C transformation in the case of strong interactions are adopted, only one of the interaction types A and V remains for fermion-fermion or fermion-boson interacting systems. (auth)

20759

SPINNING CHARGED TEST-PARTICLES IN GENERAL RELATIVITY. Anadijiban Das (Dublin Inst. for Advanced Studies). Progr. Theoret. Phys. (Kyoto) 23, 610-15(1960) Apr. (In English)

Equations of motion for charged test particles in electromagnetic or vector-meson fields are derived from Fock-Papapetrou's method. Equations for spinning charged test particles are obtained in a general covariant way. (auth)

20760

ON THE NON-LOCAL BOUNDARY CONDITION IN QUANTUM FIELD THEORY. Haruo Shimazu (Yokohama National Univ., Japan). Progr. Theoret. Phys. (Kyoto) 23, 821-8(1960) May. (In English)

The nonlocal boundary condition introduced by Bogolyubov et al. is useful for eliminating the difficulty of negative probability concerning the indefinite metric in Hilbert space. A causal description of the physical state is given in the form of an ordinary Schrödinger equation. The hamiltonian is not hermitian in general, though it gives the unitary S-matrix. Such a characteristic situation is discussed by using a simple model. (auth)

20761

INCLUSION OF HOLE MOTIONS IN BRUECKNER THEORY. Fumiaki Iwamoto (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 871-81(1960) May. (In English)

In order to include hole motions in the Brueckner method a systematic theory is developed based on a familiar treatment of small oscillations of a dynamical system about the stable point. It is shown that a slight modification in the Bethe-Goldstone equation enables us to take into account all effects coming from the couplings of particle-particle and hole-hole pairs with the same total momentum. Ground state energy is expressed with the sum of zero point energy shifts of all hole pair oscillators. Superfluidity condition found by Bogoliubov, Tolmachev, and Shirkov and by Cooper, Mills, and Sessler is also derived here as the condition for the stability of the degenerate Fermi gas state. Expression of ground state vector is given. A remark is added on the interpretation of the perturbation expansion. (auth)

20762

INFRARED SPECTRA OF HYDROGEN AND DEUTERIUM CHEMISORBED ON PLATINUM. W. A. Pliskin and R. P. Eischens (Texaco Research Center, Beacon, N. Y.). Z. physik. Chem. (Frankfurt) (N.S.) 24, 11-23(1960) Apr. (In English)

In previous work, bands attributable to hydrogen chemisorbed on metals were not observed despite many attempts to detect them. Although the "negative" nature of this evidence was realized, it was tentatively interpreted to mean that chemisorbed hydrogen is not covalently bonded to single surface metal atoms in structures of the type, M—H. In the work described, bands attributable to hydrogen chemisorbed on carrier-supported platinum were observed. This shows that the above interpretation must be modified for some cases. (auth)

20763

THE THERMODYNAMIC BEHAVIOR OF THE LIQUID Ar–Kr SYSTEM. Hans Schmidt (Universität, Göttingen, Ger.). Z. physik. Chem. (Frankfurt) (N.S.) 24, 265-74 (1960) May. (In German)

An apparatus for the measurement of liquid-steam equilibrium of binary systems of condensed gases at reduced pressure is described. The apparatus was tested by measurement on the N_2-O_2 system. Measurement results for the Ar–Kr system at 88.05°K are reported. (tr-auth)

20764

THE ELECTROLUMINESCENCE OF COPPER-ACTIVATED ZINC SULFIDE. [PART] I. G. Wendel and G. Richter (Physikalisch-Technisches Institut, Berlin). Z. Physik. Chem. (Leipzig) 214, 253-60(1960). (In German)

Activator-free ZnS, cooled in an HCl stream, was provided with a copper surface layer. From this phosphor, samples were annealed for one hour at various temperatures between room temperature and 650°C. After this treatment the phosphor was studied in an electric field. In the temperature range up to 200°C a weak electroluminescence was found, which was produced through the CuS surface layer. The green electroluminescence occurring in the samples over 600°C is a surface effect which is produced through ZnO. At 300°C Cu diffuses in the ZnS and causes a strong blue electroluminescence which disappears again in the temperature range between 500 and 570°C at a given Cu concentration. The samples show, in the measurement as the electroluminescence disappears, the synthesis of the green photoluminescence band. It was concluded that copper diffuses across interstitial points to cation points in the ZnS. (tr-auth)

20765

INFRARED RADIATION. Henry L. Hackforth. New York, McGraw-Hill Book Company, Inc., 1960. 311p. $10.00.

This book was compiled with the realization that there was a need for an introductory text on infrared radiation, its basic principles, and applications. Information is included on components and the laws of physics by which they operate, sources of radiation, methods of transmission, and the analysis and design of systems. Using a minimum of mathematics, many clear illustrations, and practical examples, an explanation is given of the versatility and inherent possibilities of infrared radiation. Applications are described which range from optical systems and medical devices to specialized instruments for satellites. This text was written for use in undergraduate college courses and for those readers desiring background information in this field. (B.O.G.)

Astrophysics and Cosmology

20766

POSSIBILITY OF A FISSION CHAIN REACTION IN SUPERNOVA TYPE I. Peter Fong (Utica Coll. of Syracuse Univ., Utica, N. Y. and California Inst. of Tech., Pasadena). Phys. Rev. 119, 241-2(1960) July 1.

The possibility of a fission chain reaction is discussed for the purpose of explaining the discrepancy between the observed light intensity of supernova type I in its decaying stage and the amount of energy available from the spontaneous fission of Cf^{254}. A convergent fission chain reaction would make the energy output many times larger while at the same time would keep the half-life of the light intensity curve the same as that of the spontaneous fission of Cf^{254}. The necessary conditions for this mechanism to contribute appreciably to the energy source do not seem to exist in supernova type I; other mechanisms are required to explain the discrepancy. (auth)

20767

COUPLING OF THE SOLAR WIND AND THE EXOSPHERE. C. P. Sonett (Space Technology Labs., Inc., Los Angeles). Phys. Rev. Letters 5, 46-8(1960) July 15.

Evidence for a solar wind and its termination of earth's magnetic field from magnetometer data collected by Pioneers I and V at altitudes greater than 14 R_e (R_e = earth radius) are discussed. On both flights, a field increase followed by a decrease rate greater than $1/r^3$ was observed in the region >13 R_e, and sharp-crested waves were seen in the field in the 12- to 13-R_e region whose amplitude rapidly diminishes beyond 14 R_e. These observations imply a stagnation boundary R_s for the solar wind in the earth's magnetic field at 13 to 14 R_e and a kinetic energy density T_ρ of ca. 10^{-10} erg/cm^3, in disagreement with $T_\rho = 2 \times 10^{-8}$ erg/cm^3 ($R_s \sim 8$ R_e) from comet data. Two possible ways of resolving this discrepancy are treated: (1) Two-step process at boundary. Low-frequency magnetoacoustic waves might be generated between the incoming wind and inelastically stopped gas and carry a considerable fraction of both the momentum and energy of the wind into the field without carrying the wind inward. The difficulties of energy dissipation are discussed. (2) Hydromagnetic waves might be refracted in the exosphere and exit on the exosphere limbs, thus removing both momentum and energy. (D.L.C.)

20768

INTERACTION OF THE SOLAR PLASMA WITH THE EARTH'S MAGNETIC FIELD. David B. Beard (Univ. of California, Davis and Lockheed Aircraft Corp., Palo Alto, Calif.). Phys. Rev. Letters 5, 89-91(1960) Aug. 1.

The reshaping and termination of the terrestrial magnetic field by the solar plasma of electrons and protons are mathematically treated for the case in which the plasma electric field (due to charge separation) creates a thin current layer beyond which the total magnetic field is zero. The magnetic field from a hemisperhical current sheath whose current density is a function of angular position is calculated to be 20 to 40% of the total magnetic field at the sheath. The component of the earth's magnetic field parallel to the sheath surface is doubled on the interior by the surface current and is canceled on the exterior of the surface; the component perpendicular to the surface is canceled on both sides of it. The equation for the earth's magnetic field in the surface is given together with that for the radius of the surface sheath; the latter is solved approximately for the daylight and night sides of the earth. (D.L.C.)

20769

ON STELLAR MODELS WITH DOUBLE ENERGY-SOURCES. Minoru Nishida (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 896-902(1960) May. (In English)

To investigate the characteristics of stellar models having double energy sources, three sample models (M = $1.2M_s$, M_s being the mass of the sun) consisting of the following regions were constructed using the newest rate of the CN-cycle: (1) hydrogen-rich envelope, (2) radiative helium region, and (3) convective helium core. A model for which the mass fraction of the helium regions is 0.6 shifts towards the left of the RR Lyrae gap in the HR-diagram from the red giant region, in which the corresponding model of Hoyle and Schwarzschild lies. This result shows that the properties of such models are very sensitive to the rates of both the hydrogen- and helium-burning. (auth)

Cosmic Radiation

20770

INFLUENCE OF GEOMAGNETIC FIELD ON EXTENSIVE

AIR SHOWERS OF COSMIC RADIATION. A. Bhaskara Rao and P. S. Gill (Muslim Univ., Aligarh, India). Indian J. Phys. 34, 153-8(1960) Apr. (In English)

G. Cocconi (1954) pointed out that the deflection of air shower particles in the earth's magnetic field should produce some ellipticity of shower structure, and hence the lateral distribution of electrons around the shower axis should not be circular, but elliptical, with the major axis in the east-west direction. This effect was investigated at Gulmarg (alt. 2710 m, 24° 36′ N-geomagnetic lat.) with two G.M. counter telescopes, for three separations 10, 25, and 40 m. The results show that there is a significant difference between the shower rates from east-west and north-south directions. This asymmetry in the shower rates is found to increase with the separation and the zenith angle of the telescopes. (auth)

20771

PHYSICAL STATE OF OUTER ATMOSPHERE AND THE ORIGIN OF RADIATION BELTS. Tatsuzo Obayashi (Radio Research Labs., Tokyo). J. Geomagnet. Geoelec. 11, 80-4 (1960). (In English)

A possible mechanism trapping high-energy particles in the radiation belts surrounding the earth is proposed, taking into account the existing hydromagnetic waves in the outer atmosphere. It is shown that there are two regions where the amplitude of hydromagnetic waves and the compressibility of gas bearing magnetic field are large. Since the acceleration mechanism is operative in such regions, particles inside the regions may be raised in their energies, and consequently they produce local inhomogeneities of hot plasmas. These hot plasmas interact with the geomagnetic field and may form a certain kind of magnetic bottles, in which the high-energy particles are likely trapped. The inner activated region is expected at the height 1,000 to 3,000 km and the outer region is of the order of 20,000 km. Although the origin of high energy particles is possibly of injected solar particles, their concentration at particular regions may be controlled considerably by the hydromagnetic nature in the outer atmosphere. (auth)

20772

ON THE HIGH ENERGY SOFT COMPONENT NEAR SEA LEVEL. Tadashi Kameda (Kobe Univ., Japan). J. Phys. Soc. Japan 15, 1175-85(1960) July. (In English)

Using an experimental arrangement consisting of GM-counter hodoscopes and an ionization chamber with a large area, the pulse height distribution of cosmic-ray showers produced by electrons or photons in lead and iron absorbers of different thickness was measured. The number of shower particles was estimated from the pulse height, considering the angular spread of shower particles, and the energy of the electrons or photons was obtained from the results of shower theory. The results of the present experiment show that: the differential energy spectra can be represented by a power law of the form $E^{-\gamma}$, with γ of 2.90 and 2.80 for electrons and photons of 2 to 20 Bev, respectively, the zenith angle distribution of electrons is expressed by $\cos^2 \theta$, and upper limit of the ratio of the number of electrons to that of photons is 1.1. It is also found that the calculated results by Ivanenko are favorable to explain the observed results for lead and iron absorbers. The essential part of this investigation is to provide a classification of the incident electrons or photons by the GM-counter hodoscopes. Single incident particles, multiple incident ones, and those associated with EAS are separated in order to minimize the ambiguity involved in the results. (auth)

20773

THE ENERGY SPECTRUM OF NUCLEI WITH CHARGE $Z \geq 6$ IN THE PRIMARY COSMIC RADIATION. S. Biswas, P. J. Lavakare, K. A. Neelakantan, and P. G. Shukla (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10) 16, 644-70(1960) May 16. (In English)

The knock-on electron technique was employed to determine the energy spectrum of nuclei with charge $Z \geq 6$ in the primary cosmic radiation. The charge and energies of the particles were determined in the following two ways: (i) for particles which are arrested in the emulsion, from measurements of range and δ-ray density; (ii) for particles which do not stop, from measurements of δ-ray density and of the energies and the angles of emission of the fast knock-on electrons; in the few cases where the particle slowed down in traversing the stack, the variation of δ-ray density along the track was determined. Measurements were made on 291 tracks obtained in a stack flown from Iowa, ($\lambda = 53°$ N), at 113,000 ft for four hours on March 13, 1956. 206 of these tracks were due to particles with charge $Z \geq 6$. The exponent of the integral energy spectrum of the medium ($6 \leq Z \leq 9$) group of nuclei was obtained as 1.65 ± 0.27 in the energy range 0.23 to 9 Bev/nucleon and that of the heavy ($Z \geq 10$) group of nuclei as 1.82 ± 0.59 in the energy interval 0.41 to 9 Bev/nucleon. The exponent for the S-group of nuclei ($Z \geq 6$) is then 1.78 ± 0.24. The geomagnetic cut-off energy at $\lambda = 54.5°$ N was estimated to be 230 Mev/nucleon. The values of the flux of M- and H-nuclei were found to be 10.7 ± 1.0 and 5.3 ± 0.7 particles/m^2 s sr, respectively, (on March 13, 1956). A comparison of these values with those obtained in other experiments shows that a Forbush type of decrease had taken place in the intensity of the heavy nuclei, similar to that observed by McDonald in the α-particle flux on the same flight; neutron monitors on ground also recorded a Forbush decrease at the same time. (auth)

20774

MEAN FREE PATH OF PRIMARY COSMIC RAYS IN THE ATMOSPHERE. R. W. Williams (Univ. of Washington, Seattle). Nuovo cimento (10) 16, 762-4(1960) May 16. (In English)

Cross section calculations are presented relating the mean free path of high-energy cosmic rays in the atmosphere to other quantities. The results are sensitive to the choice of σ (effective N-N cross section) which is identified with the average of inelastic σ_{pp} and σ_{np}; a plot of σ_{pp} vs. energy is given using proton-synchrotron beams and one cosmic ray measurement, and an energy-independent σ of ~27 mb is obtained. The interaction free path of nucleons in air is plotted as a function of the elementary N-N cross section together with the cross sections of N and O. The free path is concluded to be near 100 g cm^{-2} with an uncertainty of ~10% in the 1 to 10 Bev region and >10% in the 10 to 100 Bev region. (D.L.C.)

20775

ON THE COSMIC RAY STORMS OF JULY 1959. D. Cattani and M. Galli (Università, Bologna). Nuovo cimento (10) 16, 765-9(1960) May 16. (In English)

Counting rates of two cosmic ray scintillation monitors operating at Bologna, Italy (44.5°N), are reported for the time interval in which the cosmic ray storms of July 10 to 20, 1959, occurred. On the counting rate graph the solar flares, radioburst, SSC, Kp, and aurora are indicated. The correlation between class 3+ flares associated with radioburst and Forbush decreases is seen. The July 15 decrease occurred in less than 15 min; the other decreases on July 11 and 17 are slower. The simultaneity of the July 15 decrease with neutron count drops observed at Deep River, Canada, and at Hobart is pointed out. (D.L.C.)

20776
MEASUREMENT OF THE NEUTRON FLUX IN SPACE. Wilmot N. Hess (Univ. of California, Livermore) and Arthur J. Starnes (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Phys. Rev. Letters 5, 48-50 (1960) July 15.

Data from a $B^{10}F_3$ neutron detector mounted on an Atlas rocket pod which was flown to an altitude of 1400 km are plotted on a log count rate vs. altitude graph. The features of the plot are: (1) a sharp peak at 20 km, (2) a gradual decrease in the 50 to 1000 km range, and (3) a sharp increase beyond 1000 km. When allowance is made for background count from the pod, the curve of (2) is in fair agreement with that calculated from the assumption that neutrons in space are leakage neutrons from the atmosphere. It is concluded that the data from 100 to 1000 km are due mostly to leakage neutrons plus a not very well-known background. (D.L.C.)

20777
POSSIBLE INTERCONNECTION BETWEEN NUCLEON-STRUCTURE AND MULTIPLE PRODUCTION IN COSMIC RAY ENERGY REGIONS. Hideaki Nagai and Daisuke Itô (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto) 23, 966-7(1960) May. (In English)

Niu's fire balls (multiple particle production in cosmic rays) are shown to have a possible connection with nucleon structure using analysis of transverse momenta distributions of secondary particles. The Gaussian curve fits the histogram fairly well and is very similar to the mean square radius of the nucleon core measured in electron scattering experiments, thus showing the possible connection. (D.L.C.)

Criticality Studies

20778 AERE-R-3101
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
CRITICAL ASSEMBLIES OF AQUEOUS URANYL FLUORIDE SOLUTIONS H.A.Z.E.L. PART 4. FUEL RECOVERY. J. Hornby, D. Walmsley, G. P. Wall, and E. A. Talbot. May 1960. 12p. BIS.

Seven hundred thirty six liters of D_2O and 2.35 kg U^{235} were recovered from the aqueous uranyl fluoride fuel used in criticality studies with the HAZEL Reactor. The design, commissioning, and operation of the recovery still are described. Over-all recovery efficiencies were 100% for U and 99.7% for D_2O. (auth)

20779 CISE-73
Centro Informazioni Studi Esperienze, Milan.
CRITICALITY CALCULATIONS IN THE CASE OF A CONCENTRIC ANNULI FUEL ELEMENT LATTICE PROPOSED FOR CAN-1 REACTOR IN VIEW OF THEIR CORRELATION WITH EXPERIMENTAL MEASUREMENTS. R. Bonalumi, S. Bruschetti, and G. B. Zorzoli. Feb. 1960. 50p.

The criticality size of the CAN-1 reactor is evaluated for the case of concentric annular fuel elements. A consistent correlation method is proposed to check theoretical parameters with experimental data. The calculation is based on a preliminary correlation from Aquilon experimental data. (W.D.M.)

20780 HW-63576(p.65-9)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PHYSICS OF NUCLEAR SAFETY. Criticality Measurements of Heterogeneous 3.1 Per Cent Enriched Uranium and Water Systems. R. C. Lloyd, E. D. Clayton, R. B. Smith, and V. I. Neeley. p.65-9 of NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959.

The program of critical approach and exponential measurements of 3.063 per cent enriched uranium rods in light water was continued. Critical masses, buckling values, and some measured extrapolation length values were reported for three rod diameters (0.300, 0.600, and 0.925 inches) in previous quarterly reports. Measurements were made with rods of 0.175-inch diameter by 23.5 inches in length. These rods were encased with 0.025-inch wall Lucite tubes for insertion into hexagonal lattice frameworks. Measurements were carried out in the same manner as described previously. All lattices were moderated and completely reflected with light water. (auth)

20781 HW-63576(p.70-6)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SHAPE PERTURBATIONS IN CRITICAL EXPERIMENTS. W. A. Reardon and R. C. Lloyd. p.70-6 of NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959.

When making heterogeneous critical mass measurements, several perturbations of unknown magnitude are usually present, such as the effect of an irregular outer boundary. Critical approach type measurements were made with circular, elliptic, and rectangular cylinders to try to evaluate some of the effects. The uranium rods used were 23.5 inches long, 0.175 inches in diameter, and 3.063% U^{235}. These were encased in 0.025-inch wall Lucite tubes and were arranged in a 0.5-inch triangular lattice; the resulting H_2O/U (total) volume ratio was 8.0. The assemblies were both fully reflected and moderated with H_2O. (auth)

20782 PGR-97(R)
United Kingdom Atomic Energy Authority. Production Group. Risley, Lancs, England.
AN EMPIRICAL CORRELATION OF THE EXPERIMENTAL DATA ON HOMOGENEOUS CRITICAL ASSEMBLIES OF URANIUM AND HYDROGEN OF ALL ENRICHMENTS. B. G. Owen. Apr. 1960. 42p. BIS.

The original correlation on highly enriched uranium–hydrogen critical systems is extended to all enrichments. By using three empirical equations and the one-group buckling relations, the physical size of any uranium–hydrogen homogeneous critical assembly in simple geometry can be predicted. The predictions are compared with experiment where experimental data are available. The derived reflected spherical, infinite cylinder, and slab dimensions are shown. (auth)

20783 RFP-182
Dow Chemical Co. Rocky Flats Plant, Denver.
CRITICALITY STUDIES OF ENRICHED URANIUM METAL IN $UO_2(NO_3)_2$ SOLUTIONS. A. Goodwin, Jr., C. L. Schuske, and G. H. Bidinger. July 28, 1960. 17p. Contract AT(29-1)-1106. OTS

Neutron multiplication measurements were made on 6.5-in. diam cylindrical assemblies of enriched U discs immersed in aqueous solutions of enriched $UO_2(NO_3)_2$. Diffusion calculations were made on homogeneous mixtures of the enriched U with varying H:U atomic ratios. (auth)

Elementary Particles and Radiations

20784 CF-60-7-32
Oak Ridge National Lab., Tenn.
NEUTRON THERMALIZATION AND DIFFUSION IN

PULSED MEDIA. S. N. Purohit. July 11, 1960. 45p. Contract [W-7405-eng-26]. OTS.

A general formalism for determining the lower time eigenvalues associated with a decaying pulse of neutrons in a finite multiplying as well as nonmultiplying medium was developed. This formalism is based upon the expansion of each energy eigenfunction by a complete sum of the associated Laguerre polynomials of first order. The eigenvalues are expressed in terms of the energy transfer moments of the scattering kernel of the medium, weighted by the Maxwellian distribution. The importance of the first eigenvalue in the establishment of the final asymptotic energy distribution is discussed. In the case of a nonabsorbing infinite medium, the reciprocal of the first eigenvalue is shown to be equal to the thermalization time constant, with which the Maxwellian velocity distribution of neutrons is attained. The thermalization time constant was estimated for various moderators. For the heavy-gas case, the thermalization time constant was found to be equal to $(1.274\xi\Sigma_s v_0)^{-1}$. It is also established in this study that the relations obtained with the help of the Rayleigh-Ritz variational principle, based upon the neutron temperature concept, can be rigorously derived by using only two polynomials. The formalism presented is general and avoids the concept of neutron temperature in defining the thermalization time constant. The decay of a neutron pulse in a nonmultiplying medium is discussed in detail. For the case of multiplying medium, an analysis of an experiment is presented to indicate the importance of the time-dependent nonleakage probability in the expression of the zeroth eigenvalue. (auth)

20785 HW-63576(p.3-9)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THEORETICAL REACTOR PHYSICS AND COMPUTER PROGRAMMING. The Effect of Net Current on the Thermal Neutron Flux Near a Temperature Discontinuity. N. H. Barth. p.3-9 of NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959.

In previously reported work on the spatial and energy dependence of the thermal neutron flux near a temperature discontinuity, analytic solutions were found in plane, slab, and cylindrical geometries for the condition of no net current, and in plane geometry for a net current perpendicular to the interface. The slab and cylindrical geometry solutions are extended to include a net current perpendicular to the interface. The energy distribution of this current is characteristic of the pure Maxwellian spectrum of each region. (auth)

20786 INSJ-32

Tokyo Univ. Inst. for Nuclear Study.

A PROPOSED METHOD OF DETERMINING THE DIRECTION OF THE RELATIVISTIC PARTICLE. Minoru Oda. May 20, 1960. 9p.

A method for determining the direction of a relativistic particle is proposed. The method consists of measuring the angle of escape of Cherenkov radiation, which the particle generates, from a transparent plate. (C.J.G.)

20787 NYO-2240

Carnegie Inst. of Tech., Pittsburgh.

REACTION $p + p \rightarrow \pi^+ + p + n$ WITH POLARIZED PROTONS. Robert L. McIlwain. May 1960. 80p. Contract AT(30-1)-882. OTS.

The 53% polarized 415-Mev proton beam from the synchrocyclotron was used to bombard a liquid hydrogen target. Pions produced to the left and to the right were successively detected by means of their $\pi\mu e$ decay in a six-in. propane bubble chamber. Elastically scattered protons were used to monitor the incident beam intensity. The pions which stopped in the chamber had an average cm momentum of 0.52 μc and cm production angles between 80° and 105°. The observed pion asymmetry is $|\epsilon| = (19.9 \pm 6.5)\%$, in the same direction as the previously observed asymmetry for the (pp, π^+d) reaction. The similarity between the observed pion asymmetry and that for the (pp, π^+d) reaction suggests that their reaction amplitudes are similar, and thus that ^{3}S rather than P states are predominant for the final state nucleons in the (pp, π^+pn) reaction at this energy. (auth)

20788 NYO-2241

Carnegie Inst. of Tech., Pittsburgh.

INTERNAL PAIRS FOLLOWING π^- CAPTURE IN HYDROGEN. M. Derrick, J. G. Fetkovich, T. H. Fields, and J. Deahl. June 1960. 26p. Contract AT(30-1)-882. OTS.

Internal electron pairs from the two reactions (1) $\pi^- + p \rightarrow n + \pi^0 \rightarrow n + \gamma + e^+ + e^-$ and (2) $\pi^- + p \rightarrow n + e + e^-$ were studied in a hydrogen bubble chamber. 2184 cases were seen. A geometrical cut off selected 1523 of these as suitable for momentum measurement. By an analysis of the momentum spectrum the Panofsky ratio was measured to be 1.51 ± 0.10. The total intensity, momentum partition within the pairs, and distribution in virtual photon mass are in essential agreement with the theoretical predictions of Kroll and Wada as recently extended by Joseph. (auth)

20789 UCRL-9172

California. Univ., Berkeley. Lawrence Radiation Lab.

THE APPLICATION OF THE MANDELSTAM REPRESENTATION TO PHOTOPRODUCTION OF PIONS FROM NUCLEONS (thesis). James Stutsman Ball. Apr. 11, 1960. 79p. Contract W-7405-eng-48. OTS.

The Mandelstam representation is applied to the invariant amplitudes for photoproduction. By treating gage invariance as a subsidiary condition, it is shown that the fixed-momentum-transfer dispersion relations of Chew, Goldberger, Low, and Nambu (CGLN) are probably valid without subtractions for the (−) amplitudes while three-pion resonances would perhaps require a subtraction in the (+) amplitudes. The two-pion resonance will certainly require a subtraction for the (0) amplitudes, but to a good approximation the contribution of the two-pion intermediate state is found to produce a simple additive correction to the CGLN (0) formula. The strength of this new term is determined by a parameter Λ, which was introduced elsewhere in treating the photon, three-pion problem. Otherwise, the form of the new term can be expressed in terms of nucleon electromagnetic form factors. Finally, the photoproduction amplitudes are calculated in the threshold region, and an estimate of the size of Λ is made. (auth)

20790 UCRL-9183

California. Univ., Berkeley. Lawrence Radiation Lab.

A FURTHER STUDY OF ANTIPROTON INTERACTIONS AND THE ANNIHILATION PROCESS (thesis). Rein Silberberg. Apr. 11, 1960. 76p. Contract W-7405-eng-48. OTS.

The annihilations of 2900 ± 120 $\bar{p}$ at an average momentum of 1050 Mev/c were analysed in the 30-in. LRL propane bubble chamber. The $\bar{p}$ annihilation cross sections for hydrogen and carbon were found to be 51 ± 10 mb and 368 ± 60 mb, respectively. The $\bar{p}$ charge-exchange differential cross section peaked forward strongly. The K-meson multiplicity, $\langle N_{K\bar{K}} \rangle = 8\ (\pm 1)$ % per star, was considerably higher than at lower antiproton energies. The primary pion multiplicity

in stars with K mesons was 2.4 ± 0.5. The average pion multiplicity in stars with no strange particles was 5.0 ± 0.2 for both hydrogen and carbon. The width of the pion-multiplicity distribution function was found to be in agreement with that predicted by the Fermi statistical model with an increased interaction volume. In addition, interactions of about 853 antiprotons were analysed in emulsions. Out of these, 253 annihilated in flight in 3x gelatin emulsions, and their primary as well as secondary annihilation products were analysed. The $\bar{p}$-H elastic-scattering cross section for an energy interval from 20 to 230 Mev, with an average $\bar{p}$ energy of 150 Mev, was 56 ± 8 mb. The average annihilation cross section was 1720 ± 175 mb with AgBr, and 546 ± 105 mb for the light elements in emulsions, excluding hydrogen. The average number of charged pions observed in annihilations in flight in 3x gelatin emulsions was $\langle N_{\pi^\pm} \rangle = 2.31 \pm 0.16$. The K-meson multiplicity for annihilations in flight, at an average energy of 150 Mev, was again found to be 3.5 (±1.5) % per star. The energy in cascade nucleons and nuclear evaporation in 3x gelatin emulsions for annihilations in flight was found to be 442 ± 40 Mev per star, which corresponded to the absorption of 1.1 ± 0.20 pions per annihilation. The angular distribution of cascade protons was strongly dependent on the energy of the protons. (auth)

20791 WAPD-TM-179

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

PDQ-3—A PROGRAM FOR THE SOLUTION OF THE NEUTRON-DIFFUSION EQUATIONS IN TWO DIMENSIONS ON THE IBM-704. W. R. Cadwell. May 1960. 59p. Contract AT-11-1-GEN-14. OTS.

PDQ-3 solves the few-group, time-independent, neutron-diffusion equations over a rectangular region of the x-y plane. The number of lethargy groups is limited to four, and the number of points of solution is limited to 7500. (auth)

20792

CONTRIBUTION TO THE HEITLER-ARNOUS NON-LOCAL INTERACTION THEORY. APPLICATION TO THE CALCULATION OF THE ABNORMAL MAGNETIC MOMENT OF THE NUCLEON. Yvonne Hêno (Université, Paris). Ann. phys. (13) 5, 655-705(1960) May-June. (In French)

The introduction of non-local interaction by Heitler and Arnous for the explanation of the abnormal magnetic moment of the nucleon and the difficulties arising are discussed. The notations and general formulation of the problem are first defined. The calculation of the abnormal magnetic moment is then made in local theory in order to indicate the difficulties because of the presence of ambiguous terms. It is then shown that it is necessary to introduce high-energy coupling for the calculation. The abnormal magnetic moment of the nucleon is studied in two models of the non-local theory: the model with S matrix and the hamiltonian model. (J.S.R.)

20793

APPLICATION OF THE GROUPS OF RELATIVISTIC INVARIANCE TO THE MODELS OF EXTENDED PARTICLES IN RESTRICTED RELATIVITY. Pierre Hillion and Jean-Pierre Vigier. Compt. rend. 250, 4117-19(1960) June 20. (In French)

If one defines the particles as material distributions enclosed in hypertubes of the time type, it is seen that their movement ought to be invariant under the SL_4 group of specialized Lorentz transformations. This result is then applied to the case of elementary particles. (tr-auth)

20794

POSSIBLE FORM OF THE RELATIVISTIC WAVE FUNCTIONS ASSOCIATED WITH THE MOVEMENT AND THE STRUCTURE OF ELEMENTARY PARTICLES AT THE NUCLEAR LEVEL. Pierre Hillion and Jean-Pierre Vigier. Compt. rend. 250, 4295-7(1960) June 27. (In French)

In the case of particles with hyperspherical symmetry extended in space-time, the equations of motion are invariant under the SL_4 group of the special Lorentz transformations, and the equations describing the internal structure of the elementary particles are under the R_3^* group of complex rotations. The result is that the total wave functions pertain to irreducible representations obtained by the direct product of the irreducible representations of SL_4 and R_3^* at the nuclear level. (tr-auth)

20795

EFFECT OF ULTRASONICS ON THE EMISSION AND ABSORPTION OF γ RADIATION WITHOUT RECOIL. Anatole Abragam (Centre d'Études nucléaires, Saclay, France). Compt. rend. 250, 4334-6(1960) June 27. (In French)

It is shown that the introduction of ultrasonics in a crystal containing radioactive γ nuclei permits the frequency scanning of their Mössbauer spectrum. This allows a very precise absolute measurement of the hyperfine structure. (J.S.R.)

20796

SCATTERING OF α-PARTICLES FROM NUCLEI. W. Haeberli (Univ. of Wisconsin, Madison). Experientia 16, 218-22(1960). (In English)

After a survey of the Rutherford theory of the deflection of α particles in the electrostatic field of atomic nuclei, recent scattering experiments are indicated. The scattering of α particles on heavy nuclei is similar to an optical diffraction phantom. Resonances observed in scattering on light nuclei are comparable to acoustical resonances. (tr-auth)

20797

THE PARTICLE CONCEPT AND SOLID STATE PHYSICS. G. H. Wannier (Bell Telephone Labs., Murray Hill, N. J.). Experientia 16, 229-31(1960). (In English)

The concept of elementary particles is central in the structure of modern physics. Its origin and its historical development are illustrated. Solid-state physics has given a special contribution to this development. The contribution is the quasi-particle which causes an excitation in the solid body and which behaves as an elementary particle. It is shown that the distinction between particle and quasi-particle is not fundamental. (tr-auth)

20798

ON FERMION LOOPS OF TWO VERTICES. B. Deo (Ravenshaw Coll., Cuttack, India). Indian J. Phys. 34, 159-68(1960) Apr. (In English)

The imaginary part of the retarded matrix element for a closed loop of two vertices was deduced by perturbation theory and used to evaluate the photon and meson vacuum polarization effects by means of dispersion relations. Some difficulties regarding the mesic vacuum polarization are removed by considering the vertex correction. The formulas are used to deduce the decay rates of some elementary particles and the results obtained are in good agreement with experiments. (auth)

20799

POLARIZATION OF INTERNAL CONVERSION ELECTRONS FOLLOWING β DECAY. B. V. Geshkenbein (Inst. of Theo-

retical and Experimental Physics, Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1480-6 (1959) Dec. (In Russian)

A general expression for the polarization vector of conversion electrons for allowed transitions and first forbidden Coulomb transitions is given. Formulas are derived for magnetic, electric, and mixed magnetic–electric types of radiation, and the polarizations of conversion electrons emitted in cascade with one or several γ quanta are analyzed. (R.V.J.)

20800

EMISSION AND ABSORPTION OF GAMMA RADIATION WITHOUT RECOIL FROM AN EMITTER NUCLEUS FIXED IN A CRYSTALLINE LATTICE (MÖSSBAUER EFFECT). E. Cotton (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 265-87(1960) May. (In French)

Theoretical explanation using Debye's theory of crystals is given with calculations of absorption and self-absorption, with static and moving sources and absorbers. Results of scattering experiments are given, and applications to Zeeman effect and gravitational red shift are discussed. (auth)

20801

RESONANT ABSORPTION OF γ RADIATION WITHOUT RECOIL FROM THE NUCLEI OF Ho^{166} AND Os^{193}. A. Bussière de Nercy, M. Langevin, and M. Spighel (Faculté des Sciences, Orsay, France). J. phys. radium 21, 288-90(1960) May. (In French)

Recoilless resonant absorption was observed for the γ rays of 129 kev and 100 kev from Os^{191} and Ta^{182}. The same experimental method shows this effect for the γ rays of 80 kev and 73 kev from Ho^{166} and Os^{193}. A search for a nuclear Zeeman effect gives a maximum value of two for the magnetic moment of the 73-kev excited state of Ir^{193} (auth)

20802

PRELIMINARY RESULTS ON A MONOCHROMATIC PHOTON SOURCE BY ANNIHILATION OF POSITRONS IN FLIGHT. J. Miller, C. Schuhl, G. Tamas, and C. Tzara (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 296-8(1960) May. (In French)

We have made measurements of 28 Mev electron scattering by gold and bismuth nuclei. Angular distributions of scattered electrons have allowed us to determine the root mean square radius of the charge distribution of the two nuclei with a precision of two percent. For the parameter r_0 connected to the radius R of a homogeneous sphere considered as charge distribution model, we found the values: $r_0 = 1.17 \pm 0.02$ for gold, $r_0 = 1.15 \pm 0.03$ for bismuth. These results are in agreement with high energy electron scattering results. (auth)

20803

PROTON-PROTON SCATTERING AT 150 Mev. DIFFERENTIAL CROSS SECTION BETWEEN 30° AND 110°C.M. C. Caverzasio and A. Michalowicz (Faculté des Sciences, Orsay, France). J. phys. radium 21, 314-17(1960) May. (In French)

The differential cross section in p-p scattering at 155 Mev has been measured in a preliminary experiment between 30° and 110°C.M., using three methods: CH_2-C difference; detection of both scattered and recoil protons; analyses of pulse height spectra of scattered particles. The results are about 10% lower than those of Harwell and Harvard groups. (auth)

20804

DETERMINATION OF THE PARAMETER R IN PROTON SCATTERING AT 142 Mev. L. Birds, D. N. Edwards, B. Rose, A. E. Taylor, and E. Wood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. phys. radium 21, 329-31(1960) May. (In French)

Results are reported of a measurement of the Wolfenstein R parameter for p-p scattering at 142 Mev covering the angular range 24° to 90° c.m. These results together with other data at the same energy have been used by J. Perring in a phase shift analysis, preliminary results of which are also presented. Measurements were also made at the same energy of the R parameter for some elements. (auth)

20805

PRODUCTION AND DETECTION OF POLARIZED DEUTERONS. R. Barloutaud and H. Faraggi (Centre d'Études Nucléaires, Saclay, France); L. Rosen (Los Alamos Scientific Lab., N. Mex.); and S. M. Shafroth (Northwestern Univ., Evanston, Ill.). J. phys. radium 21, 369-72(1960) May. (In French)

The problem of producing a deuteron beam with pure vector polarization and of detecting this polarization is approached from two directions. In one experiment the polarized deuterons are generated by way of the $Be^9(p,d)$ "pick-up" reaction. In the second experiment 3.4-Mev alpha particles scatter deuterons through 145° in the c.m. system. In both experiments the polarization produced is revealed by a left-right asymmetry in the $C^{12}(d,p)C^{13}$ reaction, which is known to give rise to polarized protons when the deuterons are unpolarized. Each of the above experiments indicates significant deuteron polarization. (auth)

20806

DETERMINATION OF DEUTERON POLARIZATION AFTER A NUCLEAR REACTION. J. Raynal (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 373-4(1960) May. (In French)

After a reaction producing deuterons with a non-polarized incident beam and target, the polarization of the deuterons is described by four parameters. Two relations between them are obtained using a reaction, the inverse of which gives a known polarization, by measuring the ratios of particles going to the right, to the left and at right-angles with respect to the initial reaction. Using a different geometry, another known reaction, or rotating the spin of deuterons by a magnetic field, two more relations are obtained and the four parameters can be determined. (auth)

20807

INELASTIC SCATTERING OF NEUTRONS AT LOW ENERGY. V. Naggiar (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 384(1960) May. (In French)

The angular distributions of neutrons inelastically scattered from Fe^{56}, I^{127}, and Bi^{207} were measured in relation to the first excited level of the residual nucleus. At 3.2 Mev for Fe (850-kev level) and Bi (900-kev level) the angular distribution is isotropic at ±10%. Also measured was the asymmetry about 90° of angular distribution of neutrons inelastically scattered by I (60-kev level). No direct interaction was found. (T.R.H.)

20808

STUDY OF ELASTIC SCATTERING OF CHARGED PARTICLES USING THE OPTICAL MODEL. R. Beurtey, Guillou, and J. Raynal (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 402-5(1960) May. (In French)

Elastic scattering of 11.1 Mev protons and 44.4 Mev alpha particles was computed with different types of

optical model potentials using the Ferranti-Mercury machine. Some parameters have been varied to get the best fit with experimental values. (auth)

20809

MEASUREMENT OF THE LINEAR POLARIZATION OF GAMMA RAYS FROM CERTAIN REACTIONS. P. M. Endt, A. M. Hoogenboom, and M. Suffert (Rijksuniversiteit, Utrecht). J. phys. radium 21, 432-4(1960) May. (In French)

The linear polarization has been measured of eight different gamma rays emitted at resonances in the $Mg^{24}(p,\gamma)Al^{25}$, $Si^{30}(p,\gamma)P^{31}$, and $S^{32}(p,\gamma)Cl^{33}$ reactions. The results have resolved ambiguities for either the spin or the parity of the corresponding resonance level or for the E2/M1 mixing ratio. (auth)

20810

TRANSITION PROBABILITIES FOR ORBITAL ELECTRON CAPTURE AND K/β^+. P. Depommier, U. Nguyen-Khac, and R. Bouchez (Centre d'Études Nucléaires, Grenoble, France and Université, Grenoble, France). J. phys. radium 21, 456-60(1960) May. (In French)

Formulas are given for the transition probabilities of orbital capture and β^+ emission, in the case of VA interaction. Some K/β^+ ratios are calculated for allowed and unique transitions, taking into account screening and corrections due to the finite size of the nucleus. The values so obtained agree with the experimental values. (auth)

20811

LIFETIMES, BRANCHING RATIOS, AND ASYMMETRIES IN Σ-HYPERON DECAYS. S. C. Freden, H. N. Kornblum, and R. S. White (Univ. of California, Livermore). Nuovo cimento (10) 16, 611-24(1960) May 16. (In English)

Σ hyperons produced by the capture of K^- mesons in nuclear emulsion were studied. The mean lifetime of the Σ^+ hyperons which decay via the proton and π^+ meson modes was measured. For the proton mode using 117 decays at rest and in flight $\bar{\tau} = 8.5 \times 10^{-11}$ sec. Using the 49 decays in flight only, $\bar{\tau} = 9.5 \times 10^{-11}$ sec. For these decays the calculated lifetime is strongly dependent upon the measured Σ hyperon energies. Both statistical and systematic errors tend to lower the measured lifetime. The lifetime calculated from 37 Σ^+ decays in flight into π^+ mesons is $\bar{\tau} = 6.0 \times 10^{-11}$ sec and is essentially unchanged when a cut-off of 5×10^{-11} sec is used. No evidence exists for a short-lived component. The following branching ratios were found: $\Sigma^+ \rightarrow p + \pi^0/\Sigma^+ \rightarrow n + \pi^+ = 1.00 \pm 0.09$ and $(\Sigma^+ \rightarrow p + \gamma/\text{all } \Sigma^+) < 0.75\%$. The values for the asymmetry parameters were measured. When combined with previous data they are found to be $\alpha^0\bar{P} = -0.03 \pm 0.14$, $\alpha^+\bar{P} = 0.03 \pm 0.16$, and $\alpha^-\bar{P} = -0.14 \pm 0.75$. The superscripts refer to the charges of the decay π-mesons. (auth)

20812

PHOTOSTAR PRODUCTION BETWEEN 500 AND 1100 Mev. C. Castagnoli and M. Muchnik (Istituto Nazionale di Fisica Nucleare, Rome and Università, Rome); G. Ghigo (Comitato Nazionale per le Ricerche Nucleari, Frascati, Italy) and R. Rinzivillo (Università, Naples and Istituto Nazionale di Fisica Nucleare, Naples). Nuovo cimento (10) 16, 685-9 (1960) May 16. (In English)

Experimental results are reported on the photoproduction of stars in photographic emulsions exposed to a high-energy bremsstrahlung beam of maximum energies between 500 and 1100 Mev. The cross sections per number of equivalent quanta and per photon are calculated. The results are compared with those which can be derived using experimental values of the cross sections for single and multiple pion photoproduction. Good agreement is found. (auth)

20813

ONE-PARTICLE SINGULARITIES OF GREEN'S FUNCTIONS IN QUANTUM FIELD THEORY. [PART] II. W. Zimmermann (Universität, Hamburg and European Organization for Nuclear Research, Geneva). Nuovo cimento (10) 16, 690-704(1960) May 16. (In English)

The time ordered Green's functions are expanded with respect to the singularities arising from intermediate one-particle states. (auth)

20814

THE AXIAL VECTOR CURRENT IN BETA DECAY. M. Gell-Mann (Collège de France, Paris and Ecole Normale Supérieure, Paris) and M. Lévy (Faculte des Sciences, Orsay, France and Ecole Normale Supérieure, Paris). Nuovo cimento (10) 16, 705-26(1960) May 16. (In English)

In order to derive in a convincing manner the formula of Goldberger and Treiman for the rate of charged pion decay, the possibility is considered that the divergence of the axial vector current in β decay may be proportional to the pion field. Three models of the pion-nucleon interaction and the weak current are presented that have the required property. The first, using gradient coupling, has the advantage that it is easily generalized to strange particles and the disadvantages of being unrenormalizable and of bringing in the vector and axial vector currents in an unsymmetrical way. The second model, using a strong interaction proposed by Schwinger and a weak current proposed by Polkinghorne, is renormalizable and symmetrical between V and A, but it involves postulating a new particle and is hard to extend to strange particles. The third model resembles the second one except that it is not necessary to introduce a new particle; renormalizability in the usual sense is then lost, however. Further research along these lines is suggested, including consideration of the possibility that the pion decay rate may be plausibly obtained under less stringent conditions. (auth)

20815

THE PROBLEM OF THE Σ^-/Σ^+ RATIO IN K^--p INTERACTION IN RELATION TO THE HYPOTHESIS OF RESTRICTED SYMMETRY. M. L. Gupta (Imperial Coll., London). Nuovo cimento (10) 16, 735-48(1960) May 16. (In English)

The problem of the Σ^-/Σ^+ ratio has been discussed in the T^{-1} matrix formalism of Matthews and Salam. Global symmetry being found to be incompatible with the Σ^-/Σ^+ ratio even at threshold on the basis of new experimental data (Alvarez, Kiev Conference), consideration was given to the restricted symmetry principle for explaining the behavior of this quantity with energy. It is found that restricted symmetry is quite compatible with the experimental data on hyperon production ratios in the K^- meson-proton interaction. The difference in the phase shifts in the scattering of the systems πY and πZ in states of restricted symmetry isotopic spin $\frac{1}{2}$ and $\frac{3}{2}$ is found to be $-60°$ or $120°$, where Y and Z represent the two doublets formed out of Λ and Σ states at first proposed by Gell-Mann. It was also indicated that the conclusions about the restricted symmetry principle reached by d'Espagnat and Prentki on the basis of old experimental data are reversed when the new experimental values are substituted in place of the old ones, and the principle therefore remains quite a useful one for the interpretation of K^- meson-proton interaction phenomena. (auth)

20816

AN INVESTIGATION OF THE STABILITY OF NUCLEONS. G. K. Backenstoss, H. Frauenfelder, B. D. Hyams, L. J. Koester, Jr., and P. C. Marin (European Organization for

Nuclear Research, Geneva). Nuovo cimento (10) 16, 749-55(1960) May 16. (In English)

A search was made for relativistic charged particles emitted by the decay of nucleons. No such events were detected, and according to postulates made about the decay mode, lower limits may be set on the nucleon lifetime. These vary between 1.5×10^{26} and 2.8×10^{26} years for nucleons in many-particle nuclei and between 2.2×10^{24} and 4.7×10^{24} years for protons in hydrogen. (auth)

20817

A NOTE ON A POSSIBLE CLASSIFICATION OF STRANGENESS-2 MESONS. G. Białkowski and A. Jurewicz (Warsaw Univ.). Nuovo cimento (10) 16, 756-8(1960) May 16. (In English)

Two recently discovered unstable particles with the mass of ~1400 electron masses and called $D^{\pm}$ particles having strangeness ±2 and charge ±e are discussed in the light of four classification schemes: (1) d'Espagnat-Prentki, (2) Tiomno, (3) Pais, and (4) Salam and Polkinghorne. (4) appears to have the most natural way of introducing D particles, but its value depends on the existence of D^0. In (4), D particles can be produced by the following reactions: $\pi^- + p \rightarrow \Xi^- + D^+$, $\pi^- + p \rightarrow n + D^0$, $\pi^+ + n \rightarrow p + D^0$, $K^- + p \rightarrow K^+ + D^- + n$. D^0 decays may form a different class of reactions because of the zero strangeness of D^0. If symmetry violation slows up reactions, D^0 decays will proceed more slowly than ordinary fast reactions, but faster than ordinary slow reactions, e.g., K decays. (D.L.C.)

20818

DETERMINATION OF K^+-n P-WAVE PHASE SHIFTS FROM K^+-d REACTIONS. T. B. Day, L. S. Rodberg, G. A. Snow, and J. Sucher (Univ. of Maryland, College Park). Nuovo cimento (10) 16, 770-4(1960) May 16. (In English)

The extent to which K^+-d scattering experiments can determine the P-wave phase shifts for K^+-n scattering is examined for K^+-d cross sections at 224 Mev incident energy, using impulse and closure approximations. It is concluded that a measurement within 10% of the differential cross sections for charge exchange scattering of K^+ by d can distinguish the possible phase shifts and that their magnitude and sign can be determined. (D.L.C.)

20819

EVIDENCE FOR TWO PION-PION RESONANCES. F. Selleri (European Organization for Nuclear Research, Geneva). Nuovo cimento (10) 16, 775-9(1960) May 16. (In English)

The total $\pi^{\pm}$-p inelastic scattering is discussed with respect to evidence for π-π resonances. The 0.9-Bev σ^- maximum (σ^- = cross section for π^- scattering) is interpreted in terms of a strong π-π interaction in the I = 1 state, while the 1.3-Bev σ^+ maximum is deduced to have an I = 2 π-π resonance. The agreement of these resonances with observations on $\pi^{\pm}$-p scattering is discussed. (D.L.C.)

20820

ENERGY AND ANGULAR DISTRIBUTION OF X-RAYS PRODUCED BY 13 MEV ELECTRONS AT A THICK TARGET. Gillian Ward and G. W. Dolphin (St. Bartholomew's Hospital Medical Coll., London). Phys. in Med. Biol. 4, 391-401(1960) Apr.

Measurement of the energy distribution of photo protons produced in deuterium-loaded nuclear emulsions was used to determine the spectral distribution of a high energy x-ray beam. Details of the method are given and experimental results are compared with theory. The results of ionization chamber measurements of the angular distribution of x rays from various targets are given and discussed. A rough calculation of the fast neutron dose relative to the dose from the x-ray beam is given using data obtained from the nuclear plates. (auth)

20821

EFFECT OF MUTUAL DISTORTION ON PHASE SHIFTS OF COLLIDING SYSTEMS. Ian C. Percival (Stanford Research Inst., Menlo Park, Calif.). Phys. Rev. 119, 159-64(1960) July 1.

The box variational principle for scattering phase shifts is extended to one channel collisions of arbitrary angular momentum without exchange, and to systems with many degrees of freedom, when the energies are nonrelativistic and insufficient to produce inelastic collisions. Under reasonable assumptions of continuity it is proved that the commonly used one state and many state approximations always reduce the scattering phase shift from its correct value, so long as no further approximations have to be made, and thus provide lower bounds to the exact scattering phase shift. The distorted wave approximation is an example. The inclusion of more states into a many state approximation never makes the estimated phase any worse, and generally improves it. Mutual distortion of colliding systems never reduces the phase shift and generally increases it, thus producing an effective attraction between the systems. (auth)

20822

MEASUREMENT OF THE CIRCULAR POLARIZATION OF RESONANCE-SCATTERED GAMMA RAYS FOLLOWING THE ELECTRON CAPTURE OF Se^{75}. F. Boehm and C. J. Gallagher, Jr. (California Inst. of Tech., Pasadena). Phys. Rev. 119, 258-62(1960) July 1.

The circular polarization of the 265-kev γ rays following the mixed Gamow-Teller and Fermi electron-capture decay of Se^{75} into As^{75} was measured. The neutrino momentum was fixed with the help of a resonance scattering process. From the experimentally determined degree of right-hand circular polarization of -0.21 ± 0.15, it was concluded that the sign of the Gamow-Teller to Fermi matrix-element ratio in this beta decay is negative. (auth)

20823

DEPOLARIZATION AND TIME REVERSAL IN p-p SCATTERING AT 142 Mev. C. F. Hwang, T. R. Ophel, E. H. Thorndike, and Richard Wilson (Harvard Univ., Cambridge, Mass.). Phys. Rev. 119, 352-61(1960) July 1.

The depolarization in proton-proton scattering at 142 Mev was measured at angles of 6 to 40° in the laboratory system. The measurements were made by scattering a 67% polarized proton beam first off a liquid hydrogen target, then off a carbon (or lithium) analyzer. The scattered protons were detected by plastic scintillation counters, and the asymmetries from the last scattering were measured at each hydrogen scattering angle. The angular dependence of depolarization determined was similar to that measured at 315 Mev. The data disagree with other measurements at 143 Mev. By measuring on both sides of the beam, the polarization in scattering is determined and compared with asymmetry in scattering from a polarized beam. Their equality confirms time reversal invariance in the proton-proton interaction. (auth)

20824

PROTON-PROTON DEPOLARIZATION AT 98 Mev. E. H. Thorndike and T. R. Ophel (Harvard Univ., Cambridge, Mass.). Phys. Rev. 119, 362-5(1960) July 1.

The triple scattering depolarization parameter D for

proton-proton scattering was measured at 98 Mev, as follows: 10° (lab), 0.00 ± 0.08; 15°, 0.00 ± 0.07; 20°, 0.00 ± 0.08; 25°, −0.12 ± 0.10; 30°, −0.11 ± 0.16. (auth)

20825

CORRECTIONS TO THE IMPULSE APPROXIMATION FOR PHOTON-DEUTERON SCATTERING. R. L. Schult and R. H. Capps (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 119, 377-80(1960) July 1.

The validity of the impulse approximation for the scattering of 50 to 120 Mev photons from deuterons is investigated by the use of forward scattering dispersion relations. The only significant deviation from the impulse approximation found is in the spin-independent amplitude. Most of this deviation is shown to be the result of the exchange part of the neutron-proton potential. The exchange force is known to increase the electric dipole photodisintegration cross section. It is shown that the exchange force increases the electric dipole elastic scattering cross section by about 10 to 20%. (auth)

20826

SMALL-ANGLE PROTON-PROTON SCATTERING AT 435 Mev. S. K. Kao, H. Horstman, and G. W. Hinman (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. 119, 381-4(1960) July 1.

Results are presented of measurements of the scattering cross sections of protons by protons at 435 Mev and angles of 5 to 20° (center-of-mass). An ionization chamber was used to measure the direct beam and the scattered protons were detected by means of photographic plates. The results are substantially in agreement with other work in this range, although there is some indication of a slight minimum in the curve at the edge of the Coulomb region. (auth)

20827

Mu-MESONIC MOLECULES. I. THREE-BODY PROBLEM. Stanley Cohen, David L. Judd, and Robert J. Riddell, Jr. (Univ. of California, Berkeley). Phys. Rev. 119, 384-97(1960) July 1.

An approximate method is developed for treating a generalized hydrogen-molecule ion in which two heavy particles have positive unit charges and one light particle has a negative unit charge. The expansion parameter of this approximation is the ratio of the light to the heavy mass. In first order, the method requires finding a solution to a pair of ordinary, second-order differential equations, which are coupled unless the masses of the heavy particles are equal. Explicit expressions for the coefficients in these equations are derived. The asymptotic forms of these coefficients for large nuclear separations give to first order the reduced-mass corrections to the binding energy of the light particle on either of the two heavy particles. The usual scattering theory is extended to obtain formulas for the various possible cross sections associated with this system. An iterative, variational technique for obtaining eigenvalues and eigenfunctions for bound states of the system is presented. (auth)

20828

μ-MESONIC MOLECULES. II. MOLECULAR-ION FORMATION AND NUCLEAR CATALYSIS. Stanley Cohen, David L. Judd, and Robert J. Riddell, Jr. (Univ. of California, Berkeley). Phys. Rev. 119, 397-411(1960) July 1.

The methods developed previously are applied to the study of the behavior of μ mesons in liquid hydrogen. Numerically evaluated energy eigenvalues for the bound states of the various molecular-ion configurations are presented. Phase shifts and cross sections for the scattering of mesonic atoms from hydrogen and deuterium are given. It is shown that in the neighborhood of 0.2 ev the scattering of $(d\mu)$ atoms from protons exhibits a Ramsauer-Townsend effect with an anomalously small cross section occurring in this region. The existence of this effect provides an explanation for the appearance of "gaps" in the experimental observation of the catalytic process. The rate of exchange of mesons from protons to deuterons in pure deuterium is calculated along with the rates of formation of the $(p\mu p)^+$, $(p\mu d)^+$, and $(d\mu d)^+$ molecular ions. It is shown that the predominant mechanism for the formation of the molecular ions is dipole electron ejection. These results are shown to be in agreement with available experimental data. A semi-phenomenological treatment of the (pd) nuclear reaction is given. A rough estimate of the γ-emission process indicates that the dominant mode of emission is from the singlet proton spin states. (auth)

20829

COUPLED INTEGRAL EQUATIONS FOR THE NUCLEON AND PION ELECTROMAGNETIC FORM FACTORS. M. Baker and F. Zachariasen (Stanford Univ., Calif.). Phys. Rev. 119, 438-48(1960). July 1.

The dispersion relations for the nucleon isotopic vector form factors and the pion form factor which take into account contributions from both the 2π and NN intermediate states become a set of coupled integral equations for the form factors if the four amplitudes $(\pi\pi|NN)$ $(\pi\pi|\pi\pi)$ $(NN|\pi\pi)$ $(NN|NN)$ are assumed known. If these four amplitudes are replaced by their Born approximation values and spin and certain kinematic factors are neglected, the resulting set of coupled singular integral equations can be solved exactly. Comparison of these exact solutions with the form factors obtained from the usual approximation of retaining only the lowest mass state (i.e., the 2π state) confirms the hope that high-mass states do not contribute much to dispersion integrals. It is also of interest that these solutions are obtained from dispersion relations without subtractions and satisfy the necessary conditions that they vanish at infinite momentum transfer and take on the value e at the origin for all values of the coupling parameters appearing in the equations. (auth)

20830

CHARGED-SCALAR STRONG-COUPLING THEORY. H. Nickle and R. Serber (Columbia Univ., New York). Phys. Rev. 119, 449-57(1960) July 1.

A treatment of the charged-scalar strong-coupling theory is given which employs a somewhat different choice of variables than that usually used; one which is more convenient for a discussion of the effects of quantum mechanical field fluctuations. The expansion parameter of the strong-coupling theory is shown to be $(1/g^2)$ ln $(1/Ka)$, where a is the source radius. The isobar energy is calculated to order $1/g^4$, and terms of order $(1/g^2)$ ln $(1/Ka)$ relative to the leading $1/g^2$ term are found to appear. Similar terms occur in the charge-renormalization factor. The logarithmic term in the isobar energy is found to be precisely that required to renormalize the charge; that is, the isobar energy, if expressed in terms of the renormalized coupling constant, is explicitly independent of the source radius. (auth)

20831

TIME-DEPENDENT IMPULSE APPROXIMATION. Saul T. Epstein (Univ. of Nebraska, Lincoln). Phys. Rev. 119, 458-60(1960) July 1.

The impulse approximation is generalized to cover cases in which a bound system is subject to a time-dependent perturbation. It is shown that the approximation is exact if

the perturbation is an impulse. This result supports the supposition that the usual impulse approximation is accurate for collisions in which the collision time is short. (auth)

20832

BOSON FURRY THEOREM. D. C. Peaslee (Australian National Univ., Canberra) and M. T. Vaughn (Purdue Univ., Lafayette, Ind.). Phys. Rev. 119, 460-2(1960) July 1.

A Furry theorem for heavy mesons and photons is given for a class of highly symmetric interactions, neglecting the Ξ-N mass difference. Because of this neglect most rules are only approximately valid, but a few depend on charge conjugation alone and are absolute. (auth)

20833

THEORY OF THE LOW-ENERGY PION-PION INTERACTION. Geoffrey F. Chew and Stanley Mandelstam (Univ. of California, Berkeley). Phys. Rev. 119, 467-77(1960) July 1.

The double-dispersion representation is applied to the problem of pion-pion scattering, and it is shown that, if inelastic effects are important only at very high energies and S-wave scattering dominates at low energy, a set of integral equations for the low-energy amplitudes can be derived. The solution of these equations depends on only one arbitrary real parameter, which may be defined as the pion-pion coupling constant. The order of magnitude of the new constant is established, and a procedure for solving the integral equations by iteration is outlined. If P-wave scattering is large the equations become singular and must be modified. Such a modification can be performed, at the expense of introducing an extra parameter, but is not considered here. (auth)

20834

S-WAVE DOMINANT SOLUTIONS OF THE PION-PION INTEGRAL EQUATIONS. Geoffrey F. Chew, Stanley Mandelstam, and H. Pierre Noyes (Univ. of California, Berkeley and Univ. of California, Livermore). Phys. Rev. 119, 478-81(1960) July 1.

The integral equations for pion-pion scattering formulated by Chew and Mandelstam are put into a form suitable for numerical solution. An iteration procedure is described that is applicable when the S-wave amplitude dominates the equations, all higher partial waves being small; only solutions for which such is the case are considered. The requirement that the equations have consistent solutions without bound states turns out to limit the pion-pion coupling constant to the range $-0.46 < \lambda \lesssim 0.3$. Results are given for various values of λ within this interval. (auth)

20835

POSITRON LIFETIME IN METALS. A. Bisi, G. Faini, E. Gatti, and L. Zappa (Istituto di Fisica del Politecnico, Milan). Phys. Rev. Letters 5, 59-60(1960) July 15.

Positron lifetime measurements are reported for 18 metals ($4 \leq Z \leq 83$) with reference to Al. The experiments were conducted by evaporating one drop of $Na^{22}Cl$ solution directly on the metal targets whose thicknesses were sufficient to stop the β particles and measuring the 1.28- and 0.511-Mev γ rays which signaled the birth and death of the positron, respectively. The centroid shift of the delay curve for each metal was compared with that for Al, alternative runs being made between the metal and Al. The positron mean life in Al was found to be $2.57 \pm 0.06 \times 10^{-10}$ sec, and the table of the other results gives a difference between the lifetimes in metals and Al of $\pm 35\%$. The annihilation rates of all the metals are plotted as a function of the radius of the unit electron sphere and compared with the three theoretical curves of Sommerfeld, Ferrell, and Gerholm. (D.L.C.)

20836

OBSERVATION OF THE "ISOTOPE EFFECT" IN THE NUCLEAR CAPTURE OF NEGATIVE MUONS BY CHLORINE. W. J. Bertram, Jr., R. A. Reiter, T. A. Romanowski, and R. B. Sutton (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. Letters 5, 61-2(1960) July 15.

The isotope effect in meson (μ^-) capture by chlorine isotopes was determined with the following experimental arrangement: a 43-Mev μ^- beam from the CIT synchrocyclotron was passed through an aperture into Helmholtz coils containing enriched AgCl targets. Mesons (μ^-) and electrons stopped in the target were indicated by a setup of coincidence-anticoincidence counters. The data were analyzed on an IBM-650 computer, giving disappearance rates of $22.54 \pm 0.52 \times 10^5$ and $17.03 \pm 0.49 \times 10^5$ sec^{-1} and capture rates of $18.02 \pm 0.49 \times 10^5$ and $12.51 \pm 0.52 \times 10^5$ sec^{-1} for mesons (μ^-) in Cl^{35} and Cl^{37}, respectively. This gives a ratio of capture rates of 0.694 ± 0.034, confirming the theoretical expectation of a strong isotope effect in meson (μ) capture. (D.L.C.)

20837

FORMATION OF MUONIUM AND OBSERVATION OF ITS LARMOR PRECESSION. V. W. Hughes, D. W. McColm, and K. Ziock (Yale Univ., New Haven) and R. Prepost (Columbia Univ., New York). Phys. Rev. Letters 5, 63-5 (1960) July 15.

A search for muonium (meson (μ^+) + electron) was conducted in argon gas at high pressure, first by measuring the depolarization of mesons stopped in argon and then by examining the precession frequency of muonium in the state $(F, m_F) = (1,-1)$. Both experiments confirm the existence of muonium in argon; frequency analysis indicates that close to 100% of the mesons form muonium. The possibility of using the hyperfine structure separation of muonium in its ground state to test quantum electrodynamics is discussed. (D.L.C.)

20838

OBSERVATION OF $\pi-\pi$ RESONANCE IN PION PRODUCTION. S. D. Drell and F. Zachariasen (Stanford Univ., Calif.). Phys. Rev. Letters 5, 66-8(1960) July 15.

An experimentally feasible procedure is suggested for the purpose of seeing whether or not a resonance exists in the J = 1, T =1 state of the $\pi-\pi$ system. It is based on the analysis of the reactions $\gamma + N \rightarrow \pi + \pi + N$ (1) and $\pi + N \rightarrow \pi + \pi + N$ (2); the problem is to identify a resonance in the final-state interaction of the two outgoing pions. This can be done if the π-N interaction is held constant, and means of doing this through choice of kinematics are described. A crude estimate is made for the effect of a $\pi-\pi$ resonance on the photoproduction process (1), and it is concluded that while not much can be calculated on (1) or (2), the variations due to the density of states factor can be eliminated. (D.L.C.)

20839

CASCADE TIME OF π^- IN LIQUID HYDROGEN. T. H. Fields, G. B. Yodh, M. Derrick, and J. G. Fetkovich (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. Letters 5, 69-70(1960) July 15.

The time required for π^- to go from a velocity of 0.01c to nuclear capture in liquid H_2 was measured by scanning H_2 bubble chamber photographs of a stopping π^- beam for $\pi^- \rightarrow \mu^- \rightarrow e^-$ decays (two-kinked tracks). From a total of 80,000 π^- coming to rest, two $\pi^- \rightarrow \mu^-$ decays were observed for which velocity < 0.01c, giving a mean time for π^- to go from 0.01c to nuclear capture of 1.2×10^{-12} sec, with a statistical error of $+1.2, -0.5 \times 10^{-12}$ sec. The results are in reasonable agreement with pion absorption from S states via Stark effect mixing. (D.L.C.)

20840

EFFECTIVE-RANGE FORMULA FOR PHOTOPION PRODUCTION FROM PIONS. How-Sen Wong (Univ. of California, Berkeley). Phys. Rev. Letters 5, 70-2(1960) July 15.

A simple Mandelstam representation is given for the amplitude of the reaction $\gamma + \pi \rightarrow 2\pi$. The denominator function D_1 for p-wave π-π scattering is used in the derivation, and the assumption is made that only the two-pion intermediate state contributes to the dispersal integral, ignoring the three-pion contribution. (D.L.C.)

20841

EFFECT OF THE PION-PION RESONANCE ON THE NEGATIVE-POSITIVE RATIO. James S. Ball (Univ. of California, Berkeley). Phys. Rev. Letters 5, 73-4(1960) July 15.

The contribution of a P-wave π-π resonance is shown to be capable of producing a large effect on the π^-/π^+ ratio in pion photoproduction. The $I = \frac{1}{2}$ phases, small in the low-energy region of photoproduction, are neglected as an approximation. The magnitude of Λ, a new coupling constant for the process $\pi + \gamma \rightarrow \pi + \pi$, is discussed. (D.L.C.)

20842

T = 0 K^+–NUCLEON PHASE SHIFTS BASED ON THE OPTICAL MODEL. M. A. Melkanoff, D. J. Prowse, D. H. Stork, and H. K. Ticho (Univ. of California, Los Angeles). Phys. Rev. Letters 5, 108-11(1960) Aug. 1.

The volume integrals of the meson (K^+) nuclear potentials based on the optical model are used to obtain T = 0 phase shifts for meson (K^+)-nucleon elastic scattering at 125 and 260 Mev. Additional assumptions are made: (1) due to Coulomb and nuclear potentials, the meson (K^+) energies of 125 and 260 Mev are reduced to 93 and 230 Mev, respectively; (2) only S-wave scattering contributes in the T = 1 state; and (3) only S- and P-wave phase shifts are appreciable in the T = 0 state. Two solutions were found for a^1_{00}, a^1_{01}, and a^1_{03} and are given together with the probability of a worse fit of the data. The results are discussed with reference to earlier work; discrepancies are ascribed to the difference between the diffuse surface optical model and the square potential used by others. It is concluded that the T = 0 S-wave phase shift is small and likely to be repulsive, and that one of the T = 0 P-wave phase shifts is fairly large and attractive and the other small. (D.L.C.)

20843

p–p PHASE SHIFT SOLUTIONS AND DEPOLARIZATION SCATTERING PARAMETER AT 210 Mev. Kazuo Gotow and Ernst Heer (Univ. of Rochester, N. Y.). Phys. Rev. Letters 5, 111-12(1960) Aug. 1.

The 90% polarized proton beam was scattered at 210 Mev from a liquid hydrogen second target at an angle Θ in the plane of the first polarized scattering, and the polarizations perpendicular to the scattering plane were measured for protons scattering right and left from the second target. Separate values of the depolarization parameter, $D(\Theta)$, were calculated for the right and left scatterings from the asymmetry and p-p polarization data and then combined to give $D(\Theta) = 0.19 \pm 0.02$ and 0.33 ± 0.03 for $\Theta = 30$ and 60°, respectively. These values, plotted on a $D(\Theta)$ vs Θ graph together with all four (a,b,c,d) sets of phase shifts derived by MacGregor and Moravcsik for p-p scattering at 210 Mev, indicate that the solution b or c is the correct one with b being the more probable. (D.L.C.)

20844

CAPTURE OF K^- MESONS FROM HIGH S ORBITALS IN HELIUM. T. B. Day and G. A. Snow (Univ. of Maryland, College Park). Phys. Rev. Letters 5, 112-14(1960) Aug. 1.

The processes occurring in and after the stopping of mesons (K^-) in liquid He^4 are studied in order to find out which atomic orbital the meson will be captured from after stopping. After the capture by a He atom, the remaining electron will be kicked out via the Auger process, and the state to which the meson must fall in order to release the electron ionization energy has $n \sim 27$ and an average radius of $\sim 0.4\ a_{e1}$, which means that the resulting $(K^-,\alpha)^+$ atom will look like a proton to the surrounding He atoms. The atomic and molecular processes in which $(K^-,\alpha)^+$ can participate are examined with the assumption that $(K^-,\alpha)^+$ feels the molecular potential in the collision with a nearby He atom, enabling the Stark effect to be derived. For the high n values considered (20 to 30), the S state capture via the molecular Stark effect will be 10 to 50 times faster than the external Auger process, whereas if the meson has lower n values ~10, the dominant reaction will be capture from P states via the Stark effect. It is concluded that S-state capture will predominate. (D.L.C.)

20845

SYMMETRY BETWEEN MUON AND ELECTRON. N. Cabibbo and R. Gatto (Università, Rome and Comitato Nazionale per le Ricerche Nucleari, Rome). Phys. Rev. Letters 5, 114-16(1960) Aug. 1.

Muon-electron symmetry is treated and a definition of formal operation of this symmetry is given. It is shown that the total lagrangian, excluding weak and electromagnetic couplings, can be written in a form exhibiting such a symmetry. This symmetry cannot be satisified when universal weak interactions are included for one neutrino but is satisfied by a two-neutrino theory. The close connection between this symmetry and the principle forbidding muon transformation into electrons is pointed out. (D.L.C.)

20846

COUPLING TYPES AND STRENGTHS OF THE Y-N-K INTERACTIONS. Reiji Sugano and Akira Komatsuzawa (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 287-93 (1960) Feb. (In English)

Analyses are made on K-N scattering with use of the dispersion relations for the charge exchange scattering $K^+n \rightarrow K^0p$ and for the ordinary elastic scattering $K^+p \rightarrow K^+p$. It is shown that (ΛNK) and (ΣNK) interactions are both pseudoscalar types or pseudoscalar and scalar types, respectively. As for the interaction strengths, it is preferable that $g^2_\Lambda \approx 5$ and $g^2_\Sigma = 0$ with the existing experimental data. (auth)

20847

ON THE ELECTROMAGNETIC STRUCTURE OF NUCLEONS AND THEIR MASS DIFFERENCE. Yasuhisa Katayama, Mituo Taketani, Silvestre Ragusa, and Diogenes Rodrigues de Oliveira (Instituto de Física Teórica, São Paulo, Brazil). Progr. Theoret. Phys. (Kyoto) 23, 328-52 (1960) Feb. (In English)

A semi-phenomenological methodology is proposed for the study of the structures of elementary particles based on the problem of the electromagnetic structure of nucleons. It is convenient to separate the analyses of structure into two parts. One is the analysis of the outer structure which is characterized as the quasi-short distance and defined by $r \sim 0.5y$. Though the present field theory could be applied in this region, it is shown that the shape-independent feature also holds in so far as the present experimental information is concerned. The other is the presumption of the inner structure of the extreme short distance. A physical quantity which is effective in the analysis of this

region can be extracted by using a proposed trial model in harmony with the present experiments. A presumption comes from the electromagnetic mass difference of nucleons. The analyses are devoted to three effects: i) change of the form factors at the extreme short distance, ii) neutron charge form factor, and iii) higher order corrections of the strong interactions. These effects have qualitatively good points for the explanation of the mass difference. A small modification of the inner structure is especially quantitatively suitable to explain the experimental value. (auth)

20848

MASS DIFFERENCE BETWEEN THE SIGMA HYPERONS. Abraham Hirsz Zimerman (Instituto de Física Teórica, São Paulo, Brazil). Progr. Theoret. Phys. (Kyoto) 23, 353-65(1960) Feb. (In English)

The problem of the mass differences of the triplet sigma is discussed within the general standpoint of the electromagnetic structures of elementary particles. As the present data about these particles are very poor, many possibilities for the values of the anomalous magnetic moments are considered, especially those which according to meson theory have a reasonable magnitude and sign. Assuming the external distributions of charge and anomalous magnetic moments, as well as the magnitudes of these moments, the inner structures are estimated in order to explain the mass differences of the triplet. Effects of higher order corrections due to strong interactions are also discussed. (auth)

20849

TWO-NUCLEON POTENTIAL WITH THE "ONE-PION-EXCHANGE TAIL." [PART] II. Tetsuo Hamada (Univ. of Sydney); Junji Iwadare (Kyoto Univ.); Shoichiro Otsuki (Nagoya Univ., Japan); Ryozo Tamagaki (Hokkaido Univ., Sapporo); and Wataro Watari (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto) 23, 366-71(1960) Feb. (In English)

The p-p scattering below 100 Mev is analyzed on the basis of a static potential with the one-pion-exchange tail proposed recently from analysis around 100 Mev. This potential can reproduce all available data in this energy range quite satisfactorily. Some discussions on the depolarization parameter are given. (auth)

20850

ON THE POLARIZATION OF HIGH ENERGY NUCLEON ELASTICALLY SCATTERED FROM LIGHT NUCLEI. Yoshiyuki Sakamoto (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 382-5(1960) Feb. (In English)

The polarization of nucleons elastically scattered from light nuclei (e.g., He^4, C^{12}, O^{16}, Ca^{40}) is calculated with the aid of an optical model potential constructed from nucleon–nucleon scattering phase shifts, which were derived from the meson theoretical potential. The results are compared with those based on Gammel-Thaler and Signell-Marshak phase shifts and with the experimental data. It is concluded that the meson theoretical potential can reproduce the experimental polarization of nucleon–light nuclei scattering. (D.L.C.)

20851

A NOTE ON THE FIRST BORN APPROXIMATION IN COLLISIONS OF ELECTRON WITH HELIUM. Sigeru Huzinaga (Univ. of Chicago). Progr. Theoret. Phys. (Kyoto) 23, 562-8(1960) Apr. (In English)

Dependences of the results of the first Born approximation on the choice of the approximate wave functions of helium are examined in collision processes of electron with helium. So far the wave function $\Psi \sim \exp\{-(27/16a_0)(r_1 + r_2)\}$ was used almost exclusively as the analytical wave function of the ground state of helium. In this paper $\Psi \sim \exp\{-(\zeta/a_0)r_1 - (\zeta'/a_0)r_2\} + \exp\{-(\zeta'/a_0)r_1 - (\zeta/a_0)r_2\}$ is used. It is found that the theoretical results are quite sensitive to the values of the parameters ζ and ζ' and with suitable choices of ζ and ζ' considerable improvements in the first Born approximation can be obtained. (auth)

20852

ON HIGH ENERGY LIMIT OF FERMION-FERMION INTERACTION. Tetz Yoshimura. Progr. Theoret. Phys. (Kyoto) 23, 569-75(1960) Apr. (In English)

It is investigated what asymptotic behavior of the vertex part of the fermion-fermion interaction is compatible with Lehmann's spectral representation for the one-body propagator. In contrast to the results of Abrikosov et al., it is shown that no term may be neglected in the equation for the vertex part. (auth)

20853

S-WAVE PION-Σ-HYPERON SCATTERING. Ken Kawarabayashi and Tetsuo Sawada (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 583-96(1960) Apr. (In English)

Qualitative character of the S-wave pion-Σ hyperon scattering is investigated and compared with the corresponding S-wave pion-nucleon scattering. Information on S-wave pion-Σ hyperon scattering is obtained from K^- capture experiments which suggested large magnitudes of the phase shifts as well as large isotopic spin dependence. It is pointed out that these characteristics seem to be explained only when doublet approximation proposed by A. Pais is abandoned. Effects of the K-coupling to the S-wave pion-Σ hyperon and the S-wave K^--nucleon scattering are also discussed and the result is that absorption process reflects rather significant effect on both scatterings, especially K^--nucleon scattering, even when K meson–baryon couplings are weaker than pion–baryon couplings by an order of magnitude. (auth)

20854

PHOTODISINTEGRATION OF THE DEUTERON IN THE HIGH ENERGY RANGE. Masahiko Matsumoto (Shiga Univ., Otsu, Japan). Progr. Theoret. Phys. (Kyoto) 23, 597-609(1960) Apr. (In English)

The differential and total cross sections for the photodisintegration of the deuteron are calculated for the incident photon energies in the range from 80 to 300 Mev. A full expression of the electric interaction between the deuteron and radiation is used without expansion in terms of kr of each multipole or multipole transition. For the initial state, the pion-theoretical deuteron wave function is adopted which has almost 7% of D-state mixture. The plane wave is used for the final state. The conclusions are (1) kr expansion is not justified in the energy range $E_\gamma \gtrsim 80$ Mev and gives an underestimate for the cross sections, (2) the multipoles higher than E2 have no effect for $E_\gamma \lesssim 80$ Mev, (3) the large D-state mixture is important, and (4) the retardation effects are important at such high energy as the meson effects have to be considered. It is shown that the excitation function agrees with the observed data in the energy range if the meson effects are added to the result. (auth)

20855

ONE-PARTICLE MOTIONS IN MANY-PARTICLE SYSTEMS AND THE OPTICAL MODEL IN NUCLEAR REACTIONS. Mikio Namiki (Waseda Univ., Tokyo). Progr. Theoret. Phys. (Kyoto) 23, 629-61(1960) Apr. (In English)

A possible scheme of the systematic one-particle motion in a many-particle system is presented as a time-dependent formalism. The theory is formulated for the optical model in nuclear reactions, although it can be utilized to study

various problems in solid state physics. First the one-particle amplitude is so defined as to describe the processes of elastic scattering. Then it is shown that the systematic part of the amplitude, corresponding to the coarse-grained motion of the system, obeys the one-particle Schroedinger equation with the optical potential, and that the fluctuating part of the amplitude is governed by the Langevin-like equation with the same optical potential and by the fluctuation-dissipation theorem. The optical potential can be calculated from its definition given as the Fourier transform of the so-called "self-energy" part appearing in the equation of the one-particle Green function in the medium of the target nucleus. From the definition it is easily seen that the optical potential is, in general, nonlocal and slightly energy-dependent. The optical potential is decomposed into two parts, one being the static (or energy-independent) part to be observed in the target nucleus in the fixed ground state and the other representing reactions of nuclear excitations. The face of the optical potential may be of the same type irrespective of the question whether the incident beam is a simple short wave-packet or a mixed beam, so far as the coarse-grained motions are concerned. Finally it is proved that the fluctuation-dissipation theorem holds for the correlation function of the fluctuating source or amplitude if the system is excited in quasi-equilibrium. (auth)

20856

MASS LEVELS OF BARYONS AND MESONS. Shoji Sawada and Minoru Yonezawa (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto) 23, 662-93(1960) Apr. (In English)

The relation between the observed mass levels of baryons and mesons is investigated as well as the resonance levels in pion-nucleon and kaon-nucleon reactions and the various configurations of particle states derived from Ikeda-Ogawa-Ohnuki's symmetry theory which is based on Sakata's composite particle model. It is found that there is a close correspondence between the theoretical levels and the experimental data. (auth)

20857

ON THE MESON MASS DIFFERENCES. Gerhard Wilhelm Bünd and Paulo Leal Ferreira (Instituto de Física Teórica, São Paulo, Brazil). Progr. Theoret. Phys. (Kyoto) 23, 700-16(1960) Apr. (In English)

In view of the recent experimental evidence indicating $m_{K^0} > m_{K^+}$, in contrast with the well established result $m_{\pi^+} > m_{\pi^0}$, the problem of the electromagnetic meson self-masses is reinvestigated. A semi-phenomenological approach is used by the introduction of a nonlocal effective interaction hamiltonian, gauge invariant up to the order e^2, where new terms corresponding to one-photon and two-photon vertices are considered to take into account the effects of the strong interactions. It is shown that the contrasting experimental results can be explained as the result of the different nature of the neutral kaons as c[illegible]pared with the neutral pion. Some different ways to realize the experimental results are explicitly discussed. (auth)

20858

SECOND QUANTIZATION AND LORENTZ INVARIANCE. Shigeo Sato (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 717-30(1960) Apr. (In English)

The possibility of constructing the relativistic invariant theory using the particle representation is investigated. It is shown that the hamiltonian formalism is not adequate in this representation. The general structure of the invariant S-matrix is investigated, and some correspondences to the ordinary theory are obtained. An application to the Compton scattering is also made. (auth)

20859

PION-PION INTERACTION AND PION-NUCLEON SCATTERING. Kin-ichi Ishida, Atsushi Takahashi, and Yoshiaki Ueda (Yamagata Univ., Japan and Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto) 23, 731-48(1960) Apr. (In English)

Pion-pion interactions are analyzed by using the dispersion relation for pion-nucleon scattering obtained by keeping the momentum transfer between an initial pion and a final nucleon constant. In order to take into account the singularity of two-pion threshold in the dispersion relation, the dispersion relation may be regarded as an integral equation for pion-nucleon scattering amplitude with the kernel of a pion-pion scattering amplitude. When this solution is compared with experiments on pion-nucleon scattering, it is found that the unknown quantity in the dispersion relation is only a pion-pion scattering amplitude. Therefore, if pion-pion amplitude is expressed in terms of an unknown parameter such as scattering length, then this value can be determined via dispersion relation. Thus the following conclusion is reached: In the isotopic spin state $I = 0$ (S-wave) of pion-pion system pion-pion interaction is attractive and the scattering length is of the order of one pion Compton wavelength, while in the isotopic spin state $I = 1$ (P-wave) of pion-pion state a definite conclusion could not be obtained. Finally, the possibility of explaining the momentum dependence of pion-nucleon phase shift δ_{13} related to the pion-pion interaction is briefly discussed. (auth)

20860

NUCLEON STRUCTURE AND BEV INTERACTIONS. Daisuke Itō (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto) 23, 752-4(1960) Apr. (In English)

The partial wave cross sections of 1.4-Bev π^--p scattering were calculated using two different form factors $F(r)$ of the nucleon as a collision target, one gaussian and the other exponential, and compared with the phenomenological results. The exponential factor gave the best fit, indicating the existence of an energy-independent form factor. (D.L.C.)

20861

ENERGY LOSS AND RADIATION OF A GYRATING CHARGED PARTICLE IN A MAGNETIC FIELD. NON-IONIZED MEDIUM. Kazuo Kitao (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 759-75(1960) May. (In English)

The Fourier series expansions are used to obtain the expressions for the components of the electromagnetic field at an arbitrary point of observation and for the total energy loss of a gyrating charged particle in a non-ionized medium having a uniform magnetic field. For a nonrelativistic particle, it is shown that the total energy loss is split into the collision loss, whose formula is found to be the familiar one for linear motion, and the loss due to cyclotron radiations. The relative magnitude of the latter to the former is less than $(\omega_0/\omega_p)^2$, where ω_0 is the cyclotron frequency and $\omega_p^2 = 4\pi n_e e^2/m_e$ where n_e and m_e are the density and mass of electrons in the medium. In the relativistic case, the explicit formula of the polarization loss, depending upon the external magnetic field, and of the losses due to the Cherenkov and synchrotron radiations are obtained. The spectral and angular distributions of these two radiations are discussed. (auth)

20862

ON A NON-LOCAL ELECTROMAGNETIC MODEL FOR ELECTRON AND MUON MASSES. Jorge Leal Ferreira and Yasuhisa Katayama (Instituto de Física Teórica, São

Paulo, Brazil). Progr. Theoret. Phys. (Kyoto) 23, 776-86 (1960) May. (In English)

In a phenomenological way, a non-local electromagnetic interaction with a Pauli term is assumed in order to explain the whole masses of electron and muon. Qualitative discussions are devoted to the properties of form factors on the assumption of similar internal structures for both particles. (auth)

20863

PION-PION INTERACTION AND PION PRODUCTION IN PION-NUCLEON COLLISION. Tetsuro Sakuma (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto) 23, 810-14 (1960) May. (In English)

The evidence for the π-π interaction is investigated by considering the angular distribution of nucleon in pion production by pion-nucleon collision. It is shown that it will be quite difficult to understand the sharp forward angular distribution of nucleon without considering π-π interaction. The strength of the π-π interaction can be estimated assuming the interaction Lagrangian density $\lambda(\phi_\alpha\phi_\alpha)^2$, giving the value $|\lambda|/\sqrt{4\pi} \sim 4$. (auth)

20864

ON MULTIPOLE MODEL OF BARYON-PION INTERACTIONS. Kanji Fujii and Daisuke Itô (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto) 23, 815-20(1960) May. (In English)

The multipole model of baryon-pion interactions is developed in such a way that the quantitative comparison with experimental results is possible. In this model, the assumptions are made that the baryons correspond to the definite internal states of a nonlocal entity, and the strong and the weak interactions of baryons and pion fields are regarded as their monopole and dipole interactions, respectively. By assuming the internal wave functions of the extended baryons to be one to one admixture of the symmetric and the antisymmetric parts with respect to the simultaneous reflections both in the isobaric and the Minkowski spaces, the weak decay interactions derived from the model are shown to be equivalent to the $|\Delta| = \frac{1}{2}$ global symmetric interactions, which were recently deduced by d'Espagnat and Prentki through their phenomenological considerations. (auth)

20865

K^+-K^0 MASS DIFFERENCE. Kazuaki Daiyasu and Reiji Sugano (Osaka Univ. and Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 846-52(1960) May. (In English)

In order to explain the K^0-K^+ mass difference by means of electromagnetic interaction, the form factors in the Pauli term and in the electromagnetic-polarizability term for meson are investigated. The magnitudes of contributions from these terms are estimated for the case of the exponential form factor and compared with that from nucleons. (auth)

20866

A NOTE ON THE LEPTONIC DECAY OF HYPERONS. Ziro Maki (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto) 23, 853-8(1960) May. (In English)

The leptonic decay modes of pions and K mesons are studied from the viewpoint of compound model (Sakata model). By comparing these processes ($\pi \rightarrow \mu + \nu$ and $K \rightarrow \mu + \nu$), a conjecture for the leptonic decay of hyperons (e.g., $\Lambda \rightarrow p + \mu^- + \bar{\nu}$) is given which suggests that the squared bare coupling constant of this process is smaller than that of ordinary β decay or μ capture process of nucleons by a factor ~10. (auth)

20867

MACROSCOPIC CAUSALITY AND ANALYTICITY OF SCATTERING AMPLITUDE IN QUANTUM FIELD THEORY. Kunio Yamamoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto) 23, 859-70(1960) May. (In English)

On the basis of the macroscopic causality and the relativistic covariance it is shown that the scattering amplitudes are regular in the upper half plane as a function of the energy of the bombarding particle. This conclusion also holds for the theory in which the hamiltonian does not exist, such as nonlocal field theory, so far as the theory is covariant. In order to require the macroscopic causality the scattering is investigated by means of the wave-packet-formalism. The comparison with the result of nonrelativistic theory is also discussed. (auth)

20868

CLASSIFICATION OF COMPOSITE BOSONS IN THE SAKATA MODEL. Yoshio Yamaguchi (European Organization for Nuclear Research, Geneva). Progr. Theoret. Phys. (Kyoto) 23, 882-6(1960) May. (In English)

Assuming the Sakata model (p, n, Λ are basic, all other strongly interacting particles are composite particles) and neglecting moderately strong interactions which contribute to N-Λ mass splitting, complete symmetry between three fundamental fields (referred to as global symmetry) is found. Under this global approximation, classification of two baryon pair states, which are supposed to represent physical mesons, is described. (auth)

20869

S-WAVE PION-NUCLEON INTERACTION. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto) 23, 887-95(1960) May. (In English)

Pion-nucleon scattering in the limit of low energy is investigated in order to observe some characteristic property of pion-nucleon interaction in the nucleon core. It is pointed out that the value of coupling constant in nucleon core ought to be reduced in appearance to $f = (\mu/2M)g$ in spite of the fact that its value in the neighborhood of pion cloud is g. Moreover, some attempt to eliminate the divergence included in the dispersion relation is made on the basis of the above result, and the experimental results for s-wave phase shifts can be explained satisfactorily. (auth)

20870

THEORY OF RELATIVISTIC ROTATORS AND ELEMENTARY PARTICLES. [PART] I. Takehiko Takabayasi (Univ. of Nagoya, Japan). Progr. Theoret. Phys. (Kyoto) 23, 915-41(1960) May. (In English)

To supply a unified model of elementary particles, the theory of relativistic rotators is developed. Clarifying the physical concept of relativistic rotators, general theory is constructed on the basis of kinematical variables. Consideration of the physical properties of the internal rotational space leads to the definition of isospin and internal chirality. Other internal constants of motion are also taken out to be identified as mass and ordinary spin. Possible rotator models are classified according to the structure of the rotational part of the lagrangian. Various hitherto known models are automatically reproduced in this way, with their internal properties revealed. In addition, entirely new models follow from this scheme. (auth)

20871

DISPERSION RELATIONS IN NUCLEON-NUCLEON SCATTERING. Yasuo Hara and Hironari Miyazawa (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 942-56(1960) May. (In English)

Two-pion contribution to the absorptive part of nucleon-nucleon scattering amplitudes in the unphysical region is calculated using the dispersion relations for pion-nucleon scattering. The dispersion relations with this absorptive

part are used for analyzing nucleon-nucleon scattering data at low energy and at moderate energy, and good agreement is obtained when the coupling constant is chosen as $f^2/4\pi = 0.08 \pm 0.01$. (auth)

20872

ON THE MODEL OF ELEMENTARY PARTICLES. Yoshio Miyatake (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 957-8(1960) May. (In English)

A model of elementary particles is constructed on the basis of continuous rather than discontinuous (abrupt creation and annihilation) particle reactions. The various decay modes of particles examined in the above way yield only p, e, ν, and γ as the stable (fundamental) particles; all the others are sums of these stable particles plus an energy term G. Then, the particle reactions can be explained by the separation and addition of these stable particles. The charge distributions of p and n derived from e-p scattering appear to be favorable to the above model: the neutron can be visualized as an electron rotating around a proton. If the B^+ in Sakata's model is considered to be a composite particle constructed of p, $\bar{\nu}$, and G, then this model is similar to the above one. Possible questions to be taken up in this model are discussed. (D.L.C.)

20873

AN EXAMPLE OF NONLOCAL INTERACTION. Yoshio Miyatake (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 959-60(1960) May. (In English)

An example of a nonlocal interaction is given in the charge distribution of a proton, which is concluded to have the nonlocal effect of Markov from the macroscopic point of view. (D.L.C.)

20874

SOME CONSIDERATIONS ON THE PARITY-NON-CONSERVING INTERACTIONS IN THE THEORY OF PROPAGATORS. Tetz Yoshimura. Progr. Theoret. Phys. (Kyoto) 23, 960-2(1960) May. (In English)

The disappearance of γ_5 in field propagators having parity-nonconserving interactions for the case of Fermi interactions is shown to be not necessarily dependent on the coexistence of the STP-type and VA-type interactions, perturbation theory not being used. This case is analogous to boson-fermion interactions belonging to the second kind. (D.L.C.)

20875

ON THE UNIVERSALITY OF THE WEAK INTERACTIONS. Daisuke Itô, Shinya Furui, Kanji Fujii, and Tetsuro Sakuma (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto) 23, 962-4(1960) May. (In English)

The universality of weak decay interactions is applied to the introduction of weak interactions using a formal substitution similar to that in the electromagnetic case. The Lagrangian equation for the no-weak-interaction case is corrected by addition of multipole interaction terms for baryons and bosons and by substitution of universal lepton interaction terms. Thus, the lepton decays of hyperons and beta decays can be described, and almost all the known weak interactions can be derived qualitatively but not quantitatively. (D.L.C.)

20876

MACROSCOPIC CAUSALITY AND ANALYTICITY OF ELECTROMAGNETIC FORM FACTOR. Kunio Yamamoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto) 23, 964-5 (1960) May. (In English)

The relativistic electromagnetic form factor is studied analytically for electron–nucleon scattering amplitudes, the dependence on spin and isospin being neglected. In the case where the amplitude is independent of the total energy momentum, it and the form factor are regular in the upper half plane of Δ^2, where Δ is the invariant momentum transfer. (D.L.C.)

20877

ELEMENTARY PARTICLES OF MODERN PHYSICS. R. E. Marshak (Univ. of Rochester, N. Y.). Science 132, 269-74 (1960) July 29.

An extensive discussion of elementary particles is presented and a total of 30 particles and antiparticles is given, 7 of which are genuinely stable. The following properties are tabulated for all 30 particles: spin, mass, charge, baryon number, lepton number, strangeness number, mean life, and decay modes. Particles differing only slightly in mass may be attributed to different charge states of the same particle. Each of the properties is studied in detail, and the reasons for the construction of the strangeness number are given. The three types of forces are discussed: strong (nuclear), electromagnetic, and weak. Finally, conservation of parity, charge conjunction, and time reversal are considered. (D.L.C.)

20878

CONCERNING THE THEORY OF INELASTIC ELECTRON SCATTERING IN SOLIDS. A. Ya. Vyatskin (Leningrad Inst. of Precision Mechanics and Optics). Soviet Phys.-Solid State 2, 112-22(1960) July.

The transitions arising during Coulomb (pair) interaction of electrons with nonrelativistic energy and the lattice electrons, when examined in the light of the strong-bond approximation, are divided into two types: the interzonal free, and interzonal n-transitions. In the latter type of transition, the inelastically scattered electrons experience energy losses of a discontinuous character, which depend upon the lattice parameters. The general conclusion given, correct for the two boundary conditions (weak and strong bonds), should also be sufficiently correct for all the intermediate cases. The results can also be extended to include dielectrics and semiconductors. Most of the results obtained with the small-wave number approximation (energy emitted during n-transitions, some angular relationships) agree with the analogous results for the weak-bond approximation. The losses due to the interaction of electrons with the lattice electrons, described for the strong-bond approximation, represent the basic mechanisms of inelastic scattering. (auth)

20879

National Research Council. Committee on Nuclear Science.

PENETRATION OF CHARGED PARTICLES IN MATTER. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958. Edwin A. Uehling, ed. Nuclear Science Series Report Number 29. Publication 752. 1960. 181p. $2.00.

The Gatlinburg Conference of Sept. 1958 on the penetration of charged particles in matter featured scheduled talks on topics ranging from the reliability of experimental data to new approaches in the theoretical description of energy loss mechanisms. In addition there were unscheduled talks and informal discussions during free intervals of the four-day period. Sessions were held on stopping power and ranges, recent developments in the theory of stopping power, charge changing collisions, atomic and molecular scattering, ionization in gases by high-energy particles, and energy loss distributions. Separate abstracts were prepared for 22 of the 24 papers presented. (W.D.M.)

20880

STOPPING POWER AT LOW ENERGIES. Ward Whaling (California Inst. of Tech., Pasadena). p.1-12 of "Penetra-

tion of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

The experimental methods used in recent measurements of low-energy stopping power are described, and the results obtained by these methods are discussed. Particular attention is given to the consideration of questions of reliability. Some questions of interpretation and the need for further experimental information are mentioned. (W.D.M.)

20881

THE CURRENT STATUS OF DIRECT ENERGY LOSS MEASUREMENTS IN PURE ELEMENTS FOR PROTONS ABOVE 5 Mev. K. R. MacKenzie (Univ. of California, Los Angeles). p.13-19 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

Data on direct energy loss measurements in pure elements are compared for protons above 5 Mev. The theory of stopping power at medium energies including a knowledge of shell corrections and the presumed value of the mean ionization potential is used as a guide in normalizing the data. (W.D.M.)

20882

THE DEPENDENCE OF STOPPING POWER ON CHEMICAL BINDING. Theodore Jorgensen (Univ. of Nebraska, Lincoln). p.20-4 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

Experiments indicate that chemical binding effects may be quite large at low energies. The stopping power of protons and He ions was measured in a number of solid hydrocarbons, and the results are compared and analyzed together with similar data from other laboratories on gaseous hydrocarbons. Measurements were made on polyethylene, polystyrene, and GR-S rubber. (W.D.M.)

20883

RANGE MEASUREMENTS. Hans Bichsel (Univ. of Washington, Seattle). p.25-32 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

Measurements on the ranges of charged particles in matter are considered for the purpose of theoretical evaluation, to be followed possibly by theoretical extrapolation into areas where experimental data are unavailable. All the data on alphas below 8 Mev and the data on protons below 1.25 Mev are eliminated. The restrictions reduce the amount of data considerably. (W.D.M.)

20884

RANGE MEASUREMENTS OF SINGLY AND MULTIPLY CHARGED PARTICLES IN EMULSION. Walter H. Barkas (Univ. of California, Berkeley). p.33-48 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

Numerical values for $C(\beta)$, a correction which takes into account the binding energy corrections at low energies and the polarization corrections at high energies, for standard emulsion are tabulated. Measurements are reported on various charged particles including C^{12}, N^{14}, O^{16}, Ne^{20}, He^4, P, and Ar^{40}. (W.D.M.)

20885

PRINCIPLES OF THE STATISTICAL METHOD. Jens Lindhard (Aarhus Univ., Denmark) and Morten Scharff (Inst. of Theoretical Physics, Copenhagen). p.49-55 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

The statistical method applied to the problems of stopping power can give comprehensive and rather accurate approximations. It is based on the assumptions that electron densities are high and that many electrons contribute significantly to the phenomenon in question, so that averages may be introduced. Some aspects of the stopping problems for which perturbation methods apply are discussed. (W.D.M.)

20886

DEPENDENCE OF ENERGY LOSS ON VALENCE STATES. Werner Brandt (E. I. Du Pont de Nemours & Co., Wilmington, Del.). p.56-63 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

The dependence of stopping power of atoms on their molecular state has been pointed out by Bothe, who observed that the chemical binding should change the characteristic frequencies of the outer electrons, resulting in a changed rate of energy loss. This effect should be most noticeable in the light elements. The purpose is to combine accurate data with theory in order to interpret and interrelate the stopping power with other independently measured properties of the stopping materials. (W.D.M.)

20887

ELECTRON CAPTURE AND LOSS CROSS SECTIONS. P. M. Stier (National Carbon Co., Cleveland). p.65-71 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

A review of measurements on electron capture and loss cross sections is presented. (W.D.M.)

20888

MEASUREMENTS CONCERNING THE NEGATIVE HELIUM ION. Theodore Jorgensen (Univ. of Nebraska, Lincoln). p.72-4 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

Studies were made of the cross sections for formation and destruction of negative H ions, including some measurements on negative He ions. For the He experiments a beam of He^+ ions was passed through a differentially pumped hydrogen gas chamber 50 cm in length. The beam emergent from the chamber is analyzed by catching the charged components on Faraday chambers. (W.D.M.)

20889

SOME MEASUREMENTS ON THE FORMATION OF NEGATIVE LITHIUM IONS. Samuel K. Allison (Univ. of Chicago). p.75-7 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

Experiments with a small accelerator in the energy range 10 to 50 kev are described. Li^+ ions emitted from a hot filament coated with a lithium aluminum silicate were passed through a converter cell 10.25 cm long, into which various gases could be introduced. The emergent beam from the cell was analyzed magnetically, the Li^- and Li^+ being compared in a Faraday cup. (W.D.M.)

20890

THE SPECTROSCOPIC STUDY OF ELECTRON-CAPTURE PROCESSES. C. Y. Fan (Univ. of Chicago). p.78-81 of

"Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

When high-energy charged particles slow down in the energy range for which charge exchange collisions become one of the essential interactions with the stopping material, the energy transfer takes place in a far more complex form than when they are at high energies. Spectroscopic studies which reveal some of the interactions involved are outlined. (W.D.M.)

20891

COINCIDENCE COUNTING METHODS OF STUDYING INELASTIC IONIC COLLISIONS. J. B. Hasted (University Coll., London). p.82-9 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

Various types of events involving charge exchange are discussed, and an experimental setup is illustrated for measuring ionization and charge exchange cross sections separately by coincidence counting of the products of the collisions. (W.D.M.)

20892

TOTAL CROSS SECTIONS FOR MULTIPLE IONIZATION IN SINGLE COLLISIONS. Edgar Everhart (Univ. of Connecticut, Storrs). p.90-2 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

Total cross sections for the multiple ionization of an ion in single collisions with an atom may be obtained by integrating the measured differential cross sections over all angles of scattering. The collisions studied include He^+ incident on He, Ne, and Ar; Ne^+ on Ne and Ar; and Ar^+ on Ar at 25, 50, and 100 kev energies. (W.D.M.)

20893

CHARGE TRANSFER IN ATOMIC AND MOLECULAR HYDROGEN. E. Gerjuoy (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.95-108 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

The problems inherent in theoretical predictions of inelastic cross sections are illustrated by consideration of the simplest charge exchange reactions, $p + H \rightarrow H + p$ and $p + H_2 \rightarrow H + H_2^+$. (W.D.M.)

20894

TOTAL IONIZATION IN GASES BY HIGH-ENERGY PARTICLES: AN APPRAISAL OF OUR UNDERSTANDING. Robert L. Platzman (Purdue Univ., Lafayette, Ind.). p.109-19 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

The efficiency of ionization of gases by swiftly moving charged particles is generally measured by W, the mean energy expended per ion pair produced. Experimental values of W for alpha or beta particles in most gases lie in the range of 20 to 40 ev/ion pair and may vary with the nature and the energy of the particle. The problems that arise in the theoretical interpretation of W are discussed. (W.D.M.)

20895

A COMPARISON OF W VALUE FOR ALPHA AND BETA PARTICLES; THE ENERGY DEPENDENCE OF W. William P. Jesse (St. Procopius Coll., Lisle, Ill.). p.120-2 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

Values of W, the mean energy expended per ion pair produced, for alpha and beta particles are compared for various gases. The assumption that in argon $W_\alpha / W_\beta = 1$ is discussed in some detail. (W.D.M.)

20896

ENERGY LOSS PER ION PAIR FOR POLONIUM ALPHA PARTICLES. P. Huber (Univ. of Basel). p.123-33 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

An experimental setup for measuring the energy loss per ion pair for Po α particles is illustrated. Saturation curves as a function of pressure and field for various gases are given. (W.D.M.)

20897

ALPHA PARTICLE IONIZATION OF BINARY GAS MIXTURES. G. S. Hurst (Oak Ridge National Lab., Tenn.) and T. D. Strikler (Berea Coll., Ky.). p.134-43 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

A summary is presented of work done on alpha particle ionization of binary gas mixtures. (W.D.M.)

20898

MEASUREMENTS OF CHARACTERISTIC ENERGY LOSS OF ELECTRONS. L. B. Leder, L. Marton, H. Mendlowitz, J. Arol Simpson, and M. D. Wagner (National Bureau of Standards, Washington, D. C.). p.147-51 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

The effects which influence the energy loss values and the angular dependence of the energy losses and of the intensities are discussed in detail. Relative cross section measurements are reported. Relationships between energy loss values of electrons and other types of measurements are pointed out. (W.D.M.)

20899

SUMMARY OF ENERGY LOSS EXPERIMENTS. Hiroshi Watanabe (Hitachi Central Research Lab., Tokyo). p.152-7 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

The initial energy of the electrons used in experiments on energy loss of electrons passing through solids is ordinarily in the region of 10 to 50 kev, and energy losses of the order of 10 to 25 ev (scattering angle ranging up to 10^{-1} radian) are of especial interest. Data discussed include: value of the characteristic energy loss, comparison with optical data, angular dependence of the characteristic loss, dependence on the film thickness, and dependence on the incident angle. (W.D.M.)

20900

COMPILATION OF DIELECTRIC CONSTANT FORMULAS PRESENTED BY NOZIÈRES AND FANO. U. Fano (National Bureau of Standards, Washington, D. C.). p.158-62 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

Formulas are given on the generalized complex dielectric constant, probability of energy losses, optical properties, incoherent scattering function, and characteristic energy losses in condensed matter. (W.D.M.)

20901

COMMENTS ON "COLLECTIVE" EFFECTS IN ATOMS

AND IN EXTENDED MEDIA. U. Fano (National Bureau of Standards, Washington, D. C.). p.163-8 of "Penetration of Charged Particles in Matter. Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958." Edwin A. Uehling, ed.

The study of "plasma-type" collective effects of interaction among electrons in extended media has led to the consideration of the possible occurrence of analogous effects in isolated atoms. A discussion is presented on whether or not such effects are already implicitly taken into account in the Bethe theory, i.e., whether this theory is complete within the stated limits of the Born approximation. (W.D.M.)

Nuclear Properties and Reactions

20902 HW-63576(p.26-31)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

REACTOR PHYSICS. EFFECTIVE RESONANCE INTEGRALS OF Cu AND Au. R. A. Bennett. p.26-31 of NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959.

The effective resonance integrals of various thicknesses of Cu and Au were experimentally determined with respect to the resonance integral of a dilute "1/v" detector. The values were inferred from cadmium ratio measurements. In the analysis of the data it was assumed that the neutron energy spectrum consisted of a Maxwellian thermal component characterized by a temperature of 20.4 C and an epithermal component which varied as "1/E." The values of the effective resonance integrals and the experimental data are tabulated. The statistical uncertainties (standard deviations) in the experimental data are indicated; however, the uncertainties in the inferred results were not computed. The definitions of the tabulated quantities are contained. (auth)

20903 NP-8869

Pennsylvania. Univ., Philadelphia.

STUDIES IN PHOTONUCLEAR REACTIONS. Annual Report. June 1960. 193p. Contract AF39(638)-454.

A total of 73 photoneutron thresholds were measured with an average accuracy of 50 kev. The measured neutron separation energies were generally found to be in good agreement with the values predicted from mass data tabulations and reaction energies. The effects responsible for discrepancies between observed (γ,n) threshold energies and neutron separation energies are discussed. Activation curves measured for C and O exhibit fine structures (breaks) which are in good agreement with known level schemes. A cross section analysis for the qualitative features of the (γ,n) reaction in oxygen at 15.65 to 17.55 Mev were made. (C.J.G.)

20904 TID-5666

Oak Ridge National Lab., Tenn. and Univ. of Notre Dame, Notre Dame, Ind.

NUCLEAR SPECTROSCOPY OF NEUTRON-DEFICIENT Lu, Ta, AND Re ISOTOPES. B. Harmatz, T. H. Handley, and J. W. Mihelich. [1960?] 83p. OTS.

The systematic behavior of excited nuclear levels was studied with Lu (Z = 71), Ta (Z = 73), and Re (Z = 75) activities produced in the ORNL proton cyclotron. Conversion-electron data are presented for electron-capture decay of $Lu^{170,174m}$, $Ta^{173-178}$, and $Re^{179,181}$. Level schemes are proposed based on these and on previously published transition data for $Lu^{169,171}$. Levels in $Hf^{173,175-179}$, $Y^{169,170,173,174}$, and $W^{179,181}$ were postulated. The properties of odd-A nuclei in the strongly deformed region of odd-N numbers 95-107 are discussed in connection with predictions of Mottelson and Nilsson. Two activities, Lu^{174m} and Re^{179} (~20 min), are previously unreported. (auth)

20905

METHOD FOR THE MEASUREMENT OF THE DIFFERENTIAL CROSS SECTIONS OF ELASTIC SCATTERING OF 14-MEV NEUTRONS. G. Deconninck, G. Demortier, and A. Martegani (Centre de Physique Nucléaire, Louvain, Belg.). Ann. soc. sci. Bruxelles. Sér. I 74, 136-9(1960). (In French)

The measurement of the differential scattering cross section for 14-Mev neutrons at angles less than 6° is described. The T(d,n) reaction provides 14-Mev neutrons. The sample is in the form of a ring 3.5 cm thick and with external and internal diameters of 12 and 5 cm, respectively. The details of the geometry for the angle of 3°20′ is given, with the distance from sample to detector being 1½ m. The differential cross section for Al was measured at 3°30′, and a value of 1.42 barns/steradian was obtained. This value prolongs exactly the experimental curve. (J.S.R.)

20906

RELATION BETWEEN THE PARAMETERS OF THE SINGLET-PAIR POTENTIAL OF GAMMEL AND THALER. Michel Fabre de la Ripelle. Compt. rend. 250, 3958-9 (1960) June 13. (In French)

20907

TRANSITION CHARACTERISTICS OF RADON NUCLEI. Roger Foucher. Compt. rend. 250, 4346-8(1960) June 27. (In French)

Experimental data are presented which indicate that radon has neither stable axially deformed nuclei nor spherical nuclei. The nuclei of Rn^{222} and Rn^{220} have transition characteristics. The spectra of the first excited levels, the mean life, and the electric quadrupole moment of the first level can perhaps be explained by a nuclear model without axial symmetry. The relatively high value of the spectroscopic quadrupole moment indicates that the nuclei can not be represented by a purely γ instable nuclei. (tr-auth)

20908

AVERAGE LIFE OF THE 279-kev EXCITED LEVEL OF Tl^{203}. Serge Gorodetzky, Robert Manquenouille, Raymond Richert, and Albert Knipper (Institut de Recherches Nucléaires, Strasbourg). Compt. rend. 251, 65-7(1960) July 4. (In French)

A direct measurement of the period of the 279-kev level of Tl^{203} was made. The value found, $T_{1/2} = (2.83 \pm 0.17) \times 10^{-10}$ sec, is in good agreement with the most precise results recently reported. (tr-auth)

20909

ABSOLUTE MEASUREMENTS OF THE α ENERGIES OF RADIUM-223 AND ITS DESCENDANTS. Albrecht Rytz (Centre National de la Recherche Scientifique, Orsay, France). Compt. rend. 251, 68-9(1960) July 4. (In French)

The absolute energies of the principal α groups of Ra^{223}, Rn^{219}, and Po^{215} were measured by magnetic spectrography. The lengths are compared to a standard model, and the field is measured by nuclear resonance. (tr-auth)

20910

THE SPALLATION REACTIONS (p,pn), (p,p 2n), AND (p,3n) IN GOLD. VARIATION OF THE CROSS SECTIONS WITH ENERGY. Mark Gusakow, Yvette Legoux, and Henry Sergolle (Laboratoire de Physique Nucléaire, Orsay, France). Compt. rend. 251, 70-2(1960) July 4. (In French)

The cross sections of the reactions (p,pn), (p,p2n), and (p,3n) on gold were determined between 40 and 155 Mev. The cross section of the (p,pn) reaction has a minimum (180 mb) at 80 Mev and is 75 Mb at 155 Mev. Maxima at 40 Mev (160 mb) and at 70 Mev (70 mb) were found for the (p,3n) and (p,p2n) reactions, respectively. (tr-auth)

20911

NEW DATA ON Am^{241} DECAY. P. S. Samoilov. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1416-30(1959) Dec. (In Russian)

The electron spectra of americium from 1 to 400 kev were measured with a universal β spectrometer in order to verify the data on excitation levels and γ transitions in Np^{237}. Conversion electrons for γ transitions 42.8, 76, and 103 kev were observed and transitions 127, 159, 166, 208, and 268 kev formerly observed only with γ ray accompanying Am^{241} decay are confirmed. In addition, observations on certain conversion electrons suggest the existence of γ transitions 27, 67, 70, 123, 164.7, 234, 304.4, 333, and 369 kev. The decay scheme of Am^{241} to Np^{237} is included. (R.V.J.)

20912

STUDIES OF LUTETIUM POSITRON FRACTION. B. S. Dzhelepov, O. E. Kraft, and E. B. Kreshtofa (Leningrad State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1431-3(1959) Dec.

A triple-focusing β spectrometer was used in studies of the positron spectrum of lutetium obtained by chromatographic separation from rare earths produced in Ta bombardment by 660-Mev protons. The half lives of lutetium positrons were determined at T = 35 ± 4 hours (soft spectrum) and T = 45 ± 5 hours (hard spectrum). It is postulated that positrons with the 35-hr half life and 1200 kev energy are related to Lu^{169}, while the 45-hr half life and 2440 kev energy belong to Lu^{170}. (R.V.J.)

20913

DECAY SCHEME OF Te^{131} ($T_{1/2}$ = 30 HOURS). A. Bedesku, K. P. Mitrofanov, A. A. Sorokin, and V. S. Shpinel (Moscow State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1434-44(1959) Dec. (In Russian)

An investigation of Te^{131} decay was undertaken in order to find the order of neutron pair saturation in $3s_{1/2}$, $1h_{11/2}$, and $2d_{3/2}$ levels in I^{125}, I^{127}, I^{129}, I^{131}, and I^{133}. An attempt was made to verify the Te^{131} decay scheme and determine the characteristics of I^{131} lower levels. The first excitation level was found to be described by $5/2^+$. On the basis of the shell model, I^{131} is in the ground state at $1g_{7/2}$, and the 147 kev level is at $2d_{3/2}$. The decay scheme and the level displacements of $2d_{3/2}$ to $1g_{7/2}$ show that neutron pairs saturate the $1h_{11/2}$ level in I^{127}, I^{129}, I^{131}, and possibly I^{125}. However, further studies should be made of the decay schemes. (R.V.J.)

20914

ON 1-FORBIDDEN M1-TRANSITION (147 kev) IN I^{131}. A. A. Sorokin (Moscow State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1445-57(1959) Dec. (In Russian)

The half life of the I^{131} 147 kev level was measured by delayed coincidences with Te^{131} as the source. Six series of $\beta-\gamma$ coincidences were plotted. The half life of I^{131} was determined by retarded coincidence curves and by the shift in the curve relative to Co^{60} instantaneous coincidence curves taken at the same position. Within the order of experimental error the mean value was $T_{1/2}$ (147 kev) = $(8 \pm 1) \times 10^{-10}$ sec. The lifetime for the M1-transition is expressed by: $\tau_\gamma M1 = 1.44\,(1 + \alpha_{\text{gen M1}})(1 + \frac{E^2}{M1})T_{1/2}$, where $\alpha_{\text{gen M1}}$ is the total internal conversion coefficient for M1 = 0.25 and $E^2/M1$ is the intensity ratio of E^2 and M1 transitions. The K-shell conversion coefficient from 147 kev was measured for determing $E^2/M1$. The γ spectrum coinciding with β particles ($E_\beta > 1$ Mev) is plotted. The order of accuracy in determining $E^2/M1$ is considered quite low. (R.V.J.)

20915

DECAY SCHEME OF Hf^{181}. A. V. Borovikov, V. S. Gvozdev, I. A. Kondurov, and Yu. L. Khazov (Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1448-54(1959) Dec. (In Russian)

Excited states of Ta^{181} are formed from Hf^{181} ($T_{1/2}$ = 46 days) β decay. The total energy of Hf^{181} decay is 1023 kev. A level in Ta^{181} at 476 kev and postulations on an excited state at 958 kev (cascade transition 476 and 482 kev) were suggested previously. The present work deals with studies of the excited level of Ta^{181} at 619 kev and the determination of γ transition multiplicities from internal conversion coefficients of K and L shells and L subshells. Conversion electron spectra and β spectra were studied with a $\pi\sqrt{2}$ β spectrometer. The γ spectra and decay scheme were studied with a γ spectrometer with a multichannel analyzer and by $\gamma-\gamma$ and $\beta-\gamma$ coincidences. A corrected Hf^{181} decay scheme is included. (R.V.J.)

20916

DECAY SCHEME OF Tm^{168}. V. I. Kochvanov, R. A. Kuznetsov, A. N. Murin, V. N. Pokrovskiĭ, and L. A. Smirnov (Joint Inst. for Nuclear Research, [Dubna, USSR]). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1455-9(1959) Dec.

A long-life isotope Tm^{168} ($T_{1/2}$ = 87 days and 85 days) was found among the products of Ta spallation by 660-Mev protons. Gamma lines with 80, 100, 200, 350, 800, and 1100 kev and conversion electrons of a 79.9 kev transition were found, and the presence of previously reported γ transitions at 79.7, 99.9, 184.6, 199, 247, 448, 720, and 820 kev as well as the isomeric level $T_{1/2} = 12 \times 10^{-6}$ sec were verified. A level scheme was developed by $\gamma-\gamma$ coincidences. A preliminary scheme for Er^{168} levels is plotted, and the data obtained are tabulated. The lifetime of the metastable level, determined by resolving curves of delayed coincidences, was 0.11 ± 0.015 μsec. Experimental evaluation of α_{k200} agrees with the theoretical value in M1 multiple transition. Following the completion of the work, K. P. Jacob et al. (Bull. Am. Phys. Soc., Ser. II, 3, 358(1958)) suggested the following levels: 79.9(2^+); 264.4(4^+); 549.1(6^+); 822.0(2^+); 896.7(3^+); 996(4^+); 1095(3 and 4^-, T = 12×10^{-6} sec), and 1543.1(4^-) kev with 822, 897, and 996 kev levels forming the second rotation band. The above scheme with two additional lines at 1345 and 1720 is plotted. (R.V.J.)

20917

ANGULAR DISTRIBUTION OF PROTONS IN REACTIONS $Be^9(d,p)Be^{10}$, $Si^{28}(d,p)Si^{29}$, AND $Bi^{209}(d,p)Bi^{210}$. N. I. Zaika and O. F. Nemetz (Inst. of Physics, Academy of Sciences, Ukrainian, SSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1460-4(1959) Dec. (In Russian)

A spectrometer, based on the ionization chamber principle, was developed for measuring proton spectra. The angular distributions of protons corresponding to the excited states of Be^{10} and Si^{29} and the ground state of Bi^{210} are plotted. The silicon and bismuth radii were calculated using the formula $r_0 = (1.7 + 1.22\,A^{-1/3}) \times 10^{-13}$ cm, while for beryllium a better result is obtained with the radius equal to 4.8×10^{-13} cm, which is somewhat higher than that obtained by the formula. The spin 0^+ is assigned to the ground state of B^{10} and 1^+, 2^+, or 3^+ to the excited states. The ground state spin of Si^{28} is 0^+ and for Si^{29} has spins $3/2^+$ and $5/2^+$. The angular distributions from the second, third, and fourth levels were not found due to low proton intensities of the

respective groups. Possible spins for the fifth level are $^5/_2^-$ and $^7/_2^-$; and 3.62 Mev the shell model assigns the value $^1/_2^+$. Two characteristic proton maxima are found at 50 and 85° angles from Bi^{209}(d,p) reactions with 14 to 15 Mev deuterons. (R.V.J.)

20918

NUCLEAR REACTIONS OF MULTICHARGED IONS WITH CARBON AND OXYGEN AND THEIR INFLUENCE ON COULOMB EXCITATIONS OF NUCLEAR LEVELS. D. G. Alkhazov, A. P. Grinberg, G. M. Gusinskiĭ, and I. Kh. Lemberg. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1465-72 (1959) Dec. (In Russian)

The origin and character of γ background during investigations of Coulomb excitation of high-energy levels were studied, using γ spectra of forty elements, their compounds, and isotopes. The spectra were produced by bombardment with C^{12}, N^{16}, O^{16}, Ne^{20}, and Ne^{22} ions. A scintillation spectrometer with a NaI(Tl) crystal combined with a photomultiplier and a fifty-channel pulse analyzer was used for γ recording. The distance between the target and the crystal surface was 2.7 mm. Gamma spectra were recorded between 0.1 and 2 Mev. The background spectra were measured for bombardment events using C^{12} with E = 13.6 Mev, N^{14} with E = 11 to 40 Mev, O^{16} with E = 18.1 Mev, Ne^{20} with E = 23.1 to 27.8 Mev, and Ne^{22} with E = 25.8 Mev. The ions were accelerated by a cyclotron. (R.V.J.)

20919

NON-CONSERVATION OF PARITY IN RaE β DECAY. B. V. Geshkenbein, S. A. Nemirovskaya, and A. P. Rudik (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1473-9(1959) Dec. (In Russian)

An expression was derived for polarizations and angular distribution of β electrons in polarized RaE decay, considering the non-conservation of space and time parity. (R.V.J.)

20920

INELASTIC NEUTRON SCATTERING ON ODD NUCLEI. A. M. Korolev (Inst. of Physics, Academy of Sciences, Ukrainian, SSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz. 23, 1487-91(1959) Dec. (In Russian)

Inelastic neutron scattering on nuclei with half spins was analyzed using only weakly deformed nuclei and considering that only the two first collective levels were related to the excitation of nuclear surfaces. It is postulated that incident neutron interactions with the nuclear surfaces are small; consequently, the nucleus has only a few extra nucleons above the magic framework. The generalized Bohr model is used in the investigation. (R.V.J.)

20921

ENERGY LEVELS OF WEAKLY DEFORMED NUCLEI. A. M. Korolev (Inst. of Physics, Academy of Sciences, Ukrainian, SSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1492-6(1959) Dec. (In Russian)

A generalized nuclear model is applied in the investigation of stationary states of odd–odd nuclei with intermediate coupling. The single-photon and two-photon states were considered in determining the wave functions and energy levels. (R.V.J.)

20922

MAGNETIC AND ELECTRIC QUADRUPOLE MOMENTS IN WEAKLY DEFORMED NUCLEI. B. D. Konstantinov and A. M. Korolev (Inst. of Physics, Academy of Sciences, Ukrainian, SSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1497-1502(1959) Dec. (In Russian)

Previously derived wave functions and energy levels for odd-odd nuclei are used in the investigation of magnetic and electric quadrupole moments of nuclei in the intermediate coupling variation when it is approached from the weak side of the bond. The non-adiabatic terms and two-photon states are considered. The influence of an extra nucleon on the magnetic and quadrupole moments of nuclei was also investigated. (R.V.J.)

20923

NUCLEAR POTENTIALS AND NEUTRON STABILITY. P. E. Nemerovskiĭ (Inst. of Nuclear Energy, Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1503-10(1959) Dec. (In Russian)

Data on the one-part state of atomic nuclei, calculated using optical model potential, indicated that the order of levels in the well agrees with the shell data. Further investigations show that the optical model potential does not account for all the factors influencing the stationary state. One such factor is the nuclear force dependence on isotopic spin. The latter does not contradict charge invariance and suggests that the effective potential of the self-consistent nuclear field should also depend on N–Z. Such dependence is expressed in the Weizsacker formula by a known isotopic term. An analysis is made of the nuclear potential, and an evaluation is made of the maximum number of neutrons in a nucleus. (R.V.J.)

20924

ON THE "REPULSING" LEVELS WITH SIMILAR SPINS AND PARITIES. L. K. Peker (Leningrad State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1511-13(1959) Dec. (In Russian)

Mutually "repulsing" levels with similar spin and parity were studied, using two 2^+ levels (which are usually considered as γ vibration) in even parity W and Os isotopes. (R.V.J.)

20925

ON THE EQUILIBRIUM SHAPE OF ODD A NUCLEI WITH A = 213 TO 221 REGION. L. K. Peker (Leningrad State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1514-16(1959) Dec. (In Russian)

The characteristics of the equilibrium shape of nuclei with odd A in the region A = 213 to 221 were analyzed, even though the structure of excited levels of even-even nuclei in the identical region indicates spherical shape. The problem of odd A nuclei does not seem trivial because the odd nucleon may distort the equilibrium forces from one side to another. Data on α decay probabilities offer some information on the equilibrium shape. Quantum characteristics in α production are analyzed, and 9 events of allowed direct α transitions at A = 213 to 221 are cited. The large number of allowed direct α transitions supports a postulation of spherical equilibrium shape. In spherical nuclei the odd nucleon state is described only by the quantum number j (the complete angular moment). One level may have 2j + 1 nucleons; hence the presence of 2j + $^1/_2$ nuclei with odd value N and Z and with given j is possible. The direct α transitions followed by equilibrium distortion are tabulated. The small F values for direct α transitions in Ac^{225} and Ac^{223} indicate only a slight dependence of the Coulomb barrier penetrability deformation values. Moreover, they also show that in deformed Ac^{225} and Ac^{223} the 89th proton is at the level $^5/_2^-$, which is one of the sublevels $h_{9/2}$, because the 87th proton in Fr^{219} and Fr^{221} is at the level $h_{9/2}$ (or $f_{9/2}$). The direct α transition of $Ra^{223} \rightarrow Rn^{219}$ is strongly forbidden because the F is large. These data are in good agreement with data on the state of the 135th and 133rd neutrons. The analysis of Th^{227} and Fr^{223} showed that the state of the deformed nucleus Ra^{223} (n = 135) is probably $^3/_2^-$. The 133rd neutron in the spherical nucleus Rn^{219} is found at the level $g_{9/2}$, $g_{7/2}$, or $d_{5/2}$. The α transition between $^3/_2^- \rightarrow (^0/_2, ^1/_2, ^5/_2)^+$ should be strongly retarded. (R.V.J.)

20926

ENERGY LEVELS FOR Tl^{206} AND Bi^{210}. Yu. I. Kharitonov (Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 23, 1520-5(1959) Dec. (In Russian)

An attempt was made to calculate the energy levels of odd-odd Tl^{206} and Bi^{210} nuclei. The configurations of the nuclei differ from Pb^{208}, which has saturated neutron and proton shells through supersaturation of the two wells. Wave functions for neighboring nuclei with one nucleon or with one well in addition to the saturated shells were used in the calculations. The radial wave functions and energies of corresponding levels were previously calculated for diffusion potential. (R.V.J.)

20927

NUCLEAR RESONANT SCATTERING OF PHOTONS BY THE 1.01-Mev LEVEL OF Al^{27}. V. J. Vanhuyse and G. J. Vanpraet (Université, Ghent). J. phys. radium 21, 290-2 (1960) May. (In French)

The bremsstrahlung spectrum of 2.5-Mev electrons of a linear accelerator was used to observe the nuclear resonant scattering of photons by the 1.01-Mev excited state of Al^{27}. A self-indication method was used to define the mean life τ of this level. $\tau = (4.1\ ^{+2.3}_{-1.6}) \times 10^{-14}$ s. (auth)

20928

RESONANCE SCATTERING AND ABSORPTION OF BREMSSTRAHLUNG. A. Bussière de Nercy and M. Langevin (Faculté des Sciences, Orsay, France). J. phys. radium 21, 293-5(1960) May. (In French)

The resonance nuclear scattering of γ rays by carbon and magnesium has been studied using the bremsstrahlung beam of a betatron. The resonance scattering by the 15.1-Mev level in C^{12} was first studied. The results are in good agreement with previous experiments. With the same method the resonance scattering by a 10.5-Mev level in Mg^{24} was observed. The angular distribution of scattered photons is predominantly dipole. The peak absorption cross section is determined and permits the radiative width to the ground state and the total level width to be obtained. (auth)

20929

STUDY OF THE PHOTOPROTONS OF Nb^{93}. W. C. Barber, and V. J. Vanhuyse (Stanford Univ., Calif.). J. phys. radium 21, 299-301(1960) May. (In French)

A magnetic spectrometer was used, together with the Stanford 40-Mev linear electron accelerator, to study photoprotons from Nb^{93}. Energy and angular distributions and an excitation curve are presented and discussed. (auth)

20930

ELASTIC AND INELASTIC SCATTERING OF 155-Mev PROTONS ON CARBON. J. P. Garron, J.-C. Jacmart, L. Massonnet, M. Riou, and Ch. Ruhla (Faculté des Sciences, Orsay, France). J. phys. radium 21, 317-19 (1960) May. (in French)

Elastic and inelastic scattering differential cross sections of 155-Mev protons by carbon have been studied by a scintillation telescope between 5° and 60°. Excitation levels of 4.4, 9.6, 15, and 20 Mev have been investigated. (auth)

20931

STUDY OF pp'γ REACTIONS INITIATED BY 155-Mev PROTONS. THE CASE OF THE GIANT RESONANCE. H. Langevin-Joliot, N. Marty, and M. X. de Bouard (Faculté des Sciences, Orsay). J. phys. radium 21, 320-2(1960) May. (In French)

In order to have more information about the excitation of the giant resonance by inelastic scattering of protons, the γ rays associated with this excitation were searched. The ratio $(d\sigma_{pp'\gamma}/d\Omega)/(d\sigma_{pp'}/d\Omega)$ is given for scattering angles for protons of 10° and 25° for a C^{12} target, and 25° for an O^{16} target. (auth)

20932

STUDY OF DEUTERONS AND TRITONS EMITTED DURING BOMBARDMENT OF CARBON NUCLEI BY 155-Mev PROTONS. P. Radvanyi and J. Génin (Faculté des Sciences, Orsay, France). J. phys. radium 21, 322-5(1960) May. (In French)

The energy spectra of deuterons and tritons emitted at 15°, 30°, 60°, and 120° laboratory angles from carbon bombarded by 155-Mev protons were measured. These measurements were made with a scintillator telescope giving the kind and the energy of a charged particle by simultaneous determination of its dE/dx and E. The resulting energy spectra for deuterons and tritons, between about 30 Mev and maximum energy, are compared with the proton spectra obtained in the same conditions. An important part of the results could be explained by pick-up reactions. (auth)

20933

QUASI-ELASTIC SCATTERING OF 153-Mev PROTONS BY PROTONS IN THE p STATE OF C^{12}. T. J. Gooding and H. G. Pugh (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. phys. radium 21, 326-8(1960) May. (In French)

Energy spectra and angular correlations have been measured for the reaction $C^{12}(p,2p)B^{11}$ at 153 Mev for events in which B^{11} is left in states at low excitation. The results are consistent with the mechanism of quasi-elastic scattering when the momentum distribution of the struck protons is taken into account. (auth)

20934

FISSION-SPALLATION COMPETITION IN THORIUM TARGETS BOMBARDED BY PROTONS AT 155 Mev. [Marc] Lefort, G. Simonoff, and X. Tarrago (Faculté des Sciences, Orsay, France). J. phys. radium 21, 338-42 (1960) May. (In French)

Cross-section measurements were made on the formation of several isotopes of thorium, and actinium by bombarding Th^{232} by 155 Mev protons. These cross sections were also calculated following spallation processes in three steps: direct interaction, neutron evaporation, and fission-evaporation competition in excited nuclides. Γ_n/Γ_f values are examined and calculations are compared with experimental results. (auth)

20935

REACTIONS (p,xn) INDUCED IN GOLD BY PROTONS AT 155 Mev. N. Poffé, G. Albouy, R. Bernas, M. Gusakow, M. Riou, and J. Teillac (Faculté des Sciences, Orsay, France). J. phys. radium 21, 343-5(1960) May. (In French).

The (p,xn) cross sections for mercury production in gold have been investigated. Masses between 197 and 188 have been separated by magnetic deflection. Half lives and main γ-ray energies have been measured for Hg^{190}, Hg^{189}, Hg^{188}, and their daughter products. (auth)

20936

ANGULAR DISTRIBUTION FROM THE REACTION $Li^6(p,\alpha)He^3$ AT 100 TO 300 Kev. R. Bouchez, C. Delorme, J. Fleury, J. Krafft, P. Perrin, L. Goldman, M. Boge, and B. Dudek (Université, Grenoble, France). J. phys. radium 21, 346-8(1960) May. (In French)

The $Li^6(p,\alpha)He^3$ reaction has been studied by a 300-kv electrostatic accelerator with an optic Philips tube and a

SAMES high-voltage generator, but without analyzer, in the energy range 100 < T < 300 kev. The He^3 and α particles were observed with a scintillation (CsI) spectrometer, working in the vacuum, at laboratory angles from 30° to 150° and the spectra were measured with an intertechnique 200 channel selector. The experimental results indicate that the He^3 particles are emitted preferentially in the forward direction and for one energy as low as 100 kev. The He^3 particle angular distribution obtained for 200, 230, 270, and 300 kev cannot be described by s and p waves alone and suggests that a direct interaction process is taking place for such a low energy. (auth)

20937

ANGULAR CORRELATION (d,pγ) IN THE REACTION $Be^9(d,p)Be^{10}$. S. Gorodetzky, J. Samuel, and A. Gallmann (Institut de Recherches Nucléaires, Strasbourg). J. phys. radium 21, 349-50(1960) May. (In French)

In order to test the predictions of the distorted-wave theory of stripping reactions, the angular correlation $Be^9(d,p\gamma)Be^{10}$ in the reaction plane d-p was measured, at $E_d = 5.5$ Mev, for the first excited level of Be^{10}, at $\Phi_p = 50°$, outside the peak of the angular distribution of protons coming from this level. The preliminary results of this correlation indicate a slight shift of the symmetry axis of the curve which is no longer the recoil direction and a certain attenuation of the correlation when compared to the one measured at the peak. However, definite conclusions will only be possible after further measurements have improved the statistics. The present result, $W(\Phi) = 1 - (0.315 \pm 0.066)\cos^2(\Phi - \Phi_0)$ with $\Phi_0 = +(11 \pm 6.5)$, is not in contradiction with those obtained at 3.5-3.9 and 7.8 Mev by other authors. (auth)

20938

DIRECT INTERACTION IN THE REACTION $Be^9(n,2n)Be^8$. R. Balian and V. Gillet (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 351-2(1960) May. (In French)

The results of the application of direct interaction methods to the calculation of the cross section for the $Be^9(n,2n)Be^8$ ejection reaction are given. Energies of 0.5 and 5 Mev for outgoing neutrons are favored. The total reaction cross section, together with compound nucleus results, provides a good fit for the experimental data. (auth)

20939

NUCLEAR REACTIONS PRODUCED BY LITHIUM IONS. L. Marquez (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 355-6(1960) May. (In French)

The γ rays produced in the irradiation of Be^9 by 2 Mev Li^6 were studied. Gamma rays of 475 kev, 720 kev, and 1,020 kev were found. They correspond to the first excited state of Li^7 and to the first and second excited states of B^{10}, respectively. (auth)

20940

DIFFERENTIAL CROSS SECTION FOR THE REACTION $C^{13}(He^3,\alpha)C^{21}$ AT 1.8 Mev. R. Barjon (Université, Algiers) and M. Lambert and J. Schmouker (École Polytechnique, Paris). J. phys. radium 21, 356-7(1960) May. (In French)

The differential cross section for the $C^{13}(He^3,\alpha)C^{12}$ reaction for incident He^3 of 1.8-Mev energy and the excitation curve at a c.m. angle of 166°15′ have been measured. Explanation of the results requires a mixture of "pick-up" and "heavy-particle stripping" processes. (auth)

20941

EXCITATION CURVES FOR CERTAIN GAMMA RAYS IN THE REACTION $C^{12}(d,p)C^{13}$. S. Gorodetzky, A. Gallmann, P. Fintz, and J. Samuel (Université, Strasbourg). J. phys. radium 21, 358-9(1960) May. (In French)

Intensities of de-excitation gamma rays to the ground state from the first three levels of C^{13}, in the reaction $C^{12}(d,p)C^{13}$, were measured between $E_d = 1.2$ and 4.3 Mev. Excitation curves of the corresponding proton groups p_1, p_2, and p_3 were deduced. The experimental results have been compared with the relative intensities calculated from the penetrability factors for different values of the orbital angular momentum of the protons in the reaction $C^{13} + p$. This has made it possible to obtain information about the spins and parities of levels at 11.76, 12.41, 12.61, and 12.94 Mev in N^{14}. (auth)

20942

EXCITATION CURVES FOR GAMMA RADIATION AND INTERNAL CONVERSION PAIRS FROM $F^{19}(p,\alpha)O^{16}$ AND $Ca^{40}(p,p')Ca^{40}$, AND MEASUREMENT OF THE RELATIVE INTENSITY FOR EXTERNAL PAIRS IN THE REACTION $O^{16}(d,p)O^{17}$. S. Gorodetzky, G. Sutter, F. Scheibling, P. Chevallier, and R. Armbruster (Université, Strasbourg). J. phys. radium 21, 360(1960) May. (In French)

The measurement of excitation curves of internal conversion pairs and gamma rays coming from the reaction $F^{19}(p,\alpha)O^{16}$ has allowed determination of the most favorable region of proton bombardment energy as regards the production of monopolar pairs with a minimum competition from interfering non-monopolar pairs coming from neighboring levels. (auth)

20943

NUCLEAR REACTIONS IMPORTANT IN ASTROPHYSICS. E. Schatzman (Institut d'Astrophysique, Paris). J. phys. radium 21, 361-4(1960) May. (In French)

The nuclear reactions which are important for the understanding of the energy production rate and the chemical composition of the stars are considered. In the center of gravity system the reactions in the main sequence stars occur mainly around a few kev. The reactions of alpha particles in giant stars occur mainly around 80 kev. The reactions of carbon, $C^{12}(C^{12},p)Na^{23}$ and $C^{12}(C^{12},\alpha)Ne^{20}$ can be important at temperatures somewhat higher, the important range being around 1.5 Mev. All these reactions are important either for energy production or the change in chemical composition of the stars. Some pecularities in chemical composition oblige astrophysicists to consider surface nuclear reactions in the range 6 to 20 Mev, leading through reactions (p,n), (p,pn), and (p,2n) to the formation of neutrons and, by neutron capture (n,p), (n,γ), (n,2n), to the production of heavy elements. Many of the cross sections are only estimated, or extrapolated from much higher energies. Attention is drawn to the interest for astrophysics of the measurement of these cross sections. (auth)

20944

ELASTIC SCATTERING OF POLARIZED PROTONS AT 10 Mev BY He^3. L. Rosen (Centre d'Études Nucléaires, Saclay, France) and J. E. Brolley, Jr. (Los Alamos Scientific Lab., N. Mex.). J. phys. radium 21, 365-6 (1960) May. (In French)

A fully polarized beam of 10-Mev protons is elastically scattered by He^3 and the angular dependence of the left-right asymmetry is determined. Strong polarization effects for the back-scattered protons suggest the possibility of performing a spin-spin correlation experiment by measuring the corresponding He^3 polarization. (auth)

20945

POLARIZATION OF NEUTRONS BY THE STRIPPING RE-

ACTION $C^{12}(d,n)N^{13}$. A. Budzanowski, K. Grotowski, H. Niewodniczanski, and J. Nurzynski (Polish Academy of Sciences, Krakow). J. phys. radium 21, 366-8(1960) May. (In French)

The polarization of neutrons emitted from the stripping reaction $C^{12}(d,n)N^{13}$ has been investigated at the reaction angle $\theta_{lab} = 15°$ and deuteron energy $E_d = 12.9$ Mev. The polarization of neutrons connected with the 3.56 Mev energy level in N^{13} nucleus was found to be $-(0.39 \pm 0.11)$. Also some general remarks concerning the preliminary results of the polarization of neutrons at the reaction angles 30°, 45°, and 60° are given. (auth)

20946

STUDY OF THE DISSYMMETRY OF THE 3-Mev EXCITED STATE OF Be^8 OBTAINED BY Li^8 FORMED IN INTERACTIONS AT HIGH ENERGY. R. Stein, H. Braun, and P. Cüer (Université, Strasbourg). J. phys. radium 21, 374-5(1960) May. (In French)

Study of the energy levels, taking into consideration the reaction $Li_3^8 \rightarrow Be_4^8 \rightarrow 2\alpha$ shows the 3-Mev level to be asymmetrical. The measurements were made on individual α particles emitted by the disintegration of Be_4^8. It seems also that there is an angular anisotropy between the Li_3^8 fragment and the α particles. (auth)

20947

DISINTEGRATION SPECTRUM OF Li^8. STANDARDIZATION OF THE BUCHNER SPECTROMETER WITH THE CRONENBURG VAN DE GRAAFF. R. Bilwes, R. Seltz, M. Suffert, G. Gérardin, J. Linck, D. Magnac-Valette, and P. Cüer (Université, Strasbourg). J. phys. radium 21, 376-7(1960) May. (In French)

The deuteron beam of the Strasbourg 6-Mev Van de Graaff accelerator was used to produce Li^8 nuclei by the $Li^7(d,p)Li^8$ reaction. By means of a special design of the target assembly, which is described, only particles coming from the disintegration of Li^8 were allowed to be recorded on an Ilford E1 nuclear track plate. The result of the experiment is given. The only clear maximum corresponds to the 3-Mev level of Be^8. This level is asymmetrical with a long tail on the high-energy side up to 10 Mev according to phase shift measurements in $\alpha-\alpha$ scattering. (auth)

20948

MEASUREMENT OF CROSS SECTIONS OF SOME (n,p), (n,α), AND (n,2n) REACTIONS. J. Depraz, G. Legros, and R. Salin (Institut de Physique Nucléaire, Lyon). J. phys. radium 21, 377-9(1960) May. (In French)

Some cross sections of (n,p), (n,α), and (n,2n) reactions have been measured for neutrons of 15 Mev: $Al^{27}(n,p)Mg^{24}$, 59 ± 6 mb; $Al^{27}(n,\alpha)Na^{24}$, 116 ± 9 mb; $Fe^{56}(n,p)Mn^{56}$, 128 ± 13 mb; $Fe^{54}(n,2n)Fe^{53}$, 7 mb; $Cu^{65}(n,p)Ni^{65}$, 17 ± 4 mb; $Mg^{24}(n,p)Na^{24}$, 203 ± 11 mb; $Cu^{65}(n,2n)Cu^{64}$, 869 ± 104 mb. (auth)

20949

INELASTIC SCATTERING OF NEUTRONS AT 14 Mev BY EXCITATION OF THE 9.6-Mev LEVEL OF CARBON. M. Heyman, H. Jérémie, J. Kahane, and R. Sené (Collége de France, Paris). J. phys. radium 21, 380-2(1960) May. (In French)

The angular distribution of 14-Mev neutrons inelastically scattered by excitation of the 9.6-Mev level of carbon has been obtained by time-of-flight measurement. The result obtained by Singletary and Wood with nuclear emulsions has been improved because of smaller statistical errors. The angular distribution is asymmetric with respect to 90° to the beam, more particles being scattered into forward than into backward angles. (auth)

20950

ANGULAR DISTRIBUTION IN THE (n,n′) REACTION. M. Demeur (Université Libre, Brussels). J. phys. radium 21, 382-4(1960) May. (In French)

Nuclear stripping reactions have been studied by means of a time-dependent hamiltonian. The treatment takes into account the wave functions of the bound nucleons involved in the reaction mechanism. (auth)

20951

STUDY OF ALPHA PARTICLE INELASTIC SCATTERING AT 44.4 Mev ON Ni^{58}, Ni^{60}, AND Ni^{64}. R. Beurtey, P. Catillon, R. Chaminade, M. Crut, H. Faraggi, A. Papineau, J. Saudinos, and J. Thirion (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 399-402 (1960) May. (In French)

Using the 44.4 Mev alpha particle beam of the Saclay cyclotron, a study of the states preferentially excited in (α,α') experiments was made. The energies of these states and the angular distributions of the inelastically scattered α particles leaving the nucleus in these excited states are given. The application of the Blair inelastic diffractional calculations allows parity assignment to some of the levels. (auth)

20952

DETERMINATION OF CROSS SECTIONS OF REACTIONS PROCEEDING BY DIRECT INTERACTION IN THE RARE EARTH REGION. J. Olkowsky, I. Gratot, M. Le Pape, and L. Cohen (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 405-7(1960) May. (In French)

Cross sections of reactions involving direct mechanisms in the rare earth region were measured and found to be: $Ce^{142}(p,\gamma)Pr^{143}$, $\sigma_{11}MeV(p,\gamma) \simeq 1.2$ mb; excitation function of $Nd^{142}(p,d)Nd^{141}$, $E_p \leq 11$ MeV; and excitation function of $Nd^{142}(\alpha,\alpha n)Nd^{141}$, $E_\alpha \leq 44$ MeV. (auth)

20953

GAMMA- AND X-RAY YIELD AND SPECTRA FOR SUPPORTS OF TARGETS BOMBARDED BY PROTONS OF LOW ENERGIES: 0.3 TO 1 Mev. J. Depraz, G. Legros, and R. Salin (Institut de Physique Nucléaire, Lyon). J. phys. radium 21, 412-16(1960) May. (In French)

Backing materials of thin targets can also emit x and γ rays. Yields and spectra of x and γ rays produced by copper, molybdenum, silver, tin, tantalum, and gold are determined. The most favorable material seems to be tantalum. (auth)

20954

VIBRATIONAL EXCITATION OF EVEN-EVEN NUCLEI. Maurice Jean (Faculté des Sciences, Orsay, France). J. phys. radium 21, 416-23(1960) May. (In French)

A short survey is given of the present situation in the systematics and the interpretation of the low lying excited states of even-even nuclei in the region between the magic nuclei and the strongly deformed ones. (auth)

20955

PARTIAL TRANSITION WIDTHS FOR J = 1 SPIN LEVELS OF W^{184} AND Pt^{196} EXCITED BY INTERMEDIATE NEUTRON CAPTURE. J. Julien, C. Corge, V.-D. Huynh, F. Netter, and J. Simic (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 423-5(1960) May. (In French)

The J = 1 levels excited by resonance neutron capture have been studied for W and Pt. The relative transition probabilities to the ground state or to the first excited levels show some fluctuations from level to level. In order to analyze the distributions of the partial radiation width, it has been assumed, as Porter and Thomas did, that the correct distribution is a χ^2 distribution. (auth)

20956

RESONANCE PARAMETERS OBSERVED FOR THE ABSORPTION OF INTERMEDIATE NEUTRONS BY W AND Pt. C. Corge, V.-D. Huynh, J. Julien, S. Mirza, F. Netter, and J. Simic (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 426-8(1960) May. (In French)

The resonance analysis in terms of the one level Breit and Wigner formula has been performed to derive the level parameter values of W^{183} and Pt^{195}($5 \cdot 10^{-3}$ μs/m resolution). Fluctuations in neutron width Γ_n and fluctuations in reduced neutron width Γ_n^0 are consistent with a chi-squared distribution with $\nu = 1$, while fluctuations in total radiative width Γ_γ for $Pt^{195} + n$ imply a surprisingly low value of $\nu(\nu = 9)$ in view of the hypothesis of the independence of the partial radiative width distributions. The strength function values obtained do not disagree with the theoretical ones. (auth)

20957

MEASUREMENT AND ANALYSIS OF THE FISSION CROSS SECTION OF URANIUM-235. A. Michaudon, R. Bergère, A. Coin, and R. Joly (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 429-32(1960) May. (In French)

The uranium-235 fission cross section has been remeasured by the time-of-flight technique with the Saclay 28 Mev linear electron accelerator as a pulsed neutron source. The resolution was 0.01 μs/m in the whole energy range (7 to 95 ev). Fission was detected with an ionization chamber and neutron spectrum measured with an assembly of BF_3 counters. Improvements in resolution, statistical accuracy, and background are described. Area analysis of the resonances gives a set of $\sigma_0\Gamma_f$ values. Shape analysis of the low energy resonances has been undertaken, including that at 8.78 ev, where a large broadening is seen and this is discussed. (auth)

20958

HALF-LIFE OF 595-kev EXCITED STATE OF In^{115}. S. Gorodetzky, R. Manquenouille, R. Richert, and A. Knipper (Institut de Recherches Nucléaires, Strasbourg). J. phys. radium 21, 439-42(1960) May. (In French)

The rate of emission of the electric quadrupole transition following the decay of the state at 595 kev of In^{115} is found to be a factor 2 enhanced over the single particle estimate. The half life of this level is $T_{1/2} = (5.9 \pm 0.3) \times 10^{-9}$ seconds. (auth)

20959

MEASUREMENT OF THE BETA-GAMMA CIRCULAR POLARIZATION CORRELATION IN Au^{198} AND Sb^{122}. M. de Croës, J. P. Deutsch, and P. Lipnik (Université, Louvain, Belg.). J. phys. radium 21, 442-5(1960) May. (In French)

Beta-gamma polarization correlation measurements yield the preliminary result $A = 0.44 \pm 0.07$ for Au^{198} and $A = 0.27 \pm 0.07$ for Sb^{122}. A detailed description of the polarimeter used is given elsewhere. (auth)

20960

QUADRUPOLE MOMENTS OF SOME HEAVY NUCLEI AND COLLECTIVE MODELS. R. Foucher (Laboratoire de Physique Nucléaire, Orsay, France). J. phys. radium 21, 445-6(1960) May. (In French)

Values of quadrupole moments for Rn^{220}, Rn^{222}, Ra^{224}, Ra^{226}, and U^{234} obtained from half lives of 2 + excited states and α-γ angular correlations are compared. (auth)

20961

STUDY OF SOME LEVELS OBTAINED DURING ALPHA DECAY OF Th^{227} (RaAc). G. Y. Petit (Faculté des Sciences, Orsay, France). J. phys. radium 21, 447-8(1960) May. (In French)

20962

BETA-GAMMA ANGULAR CORRELATION AT RESONANCE: Kr^{85} AND As^{76}. Maurice Spighel (Faculté des Sciences, Orsay, France). J. phys. radium 21, 449-50 (1960) May. (In French)

The 150 kev level of Rb^{85} has been measured using the method of scattered γ resonance and delayed coincidences. The half life is $T_{1/2} = (5.5 \pm 2.5) \times 10^{-10}$ s. The 560 kev resonance scattered γ from Se^{76} has been found, with the β of As^{76}. It is possible, to choose between some hypotheses the type of interaction with the observed angular correlation. The different possibilities are examined in the light of recent experimental results. (auth)

20963

CALCULATIONS ON MUON CAPTURE BY NUCLEI. G. Goulard and B. Goulard (Centre d'Études Nucléaires, Grenoble, France and Université, Grenoble, France). J. phys. radium 21, 452-5(1960) May. (In French)

A general formula was obtained for the capture probability of a negative muon by a nucleus, using spherical tensors. The non-relativistic approximation was used, and the nuclear matrix elements were calculated by the choice of an independent particle shell model. These results were then applied to the capture probability by some nuclei near calcium in order to evaluate the ratio of Gamow-Teller to Fermi coupling. (auth)

20964

RADIATION FROM MESOTHORIUM I(Ra^{228}). J. Tousset (Institut de Physique Nucléaire, Lyon). J. phys. radium 21, 461-2(1960) May. (In French)

A technique for preparation of thin Ms Th 1 and Ms Th 2 sources is described. The electron spectra of these sources, in a double-focusing magnetic spectrometer, revealed, for Ms Th 1, a strong group of conversion lines at 5.5; 6.3; 10.1 kev. These lines are attributable to a 10.4 kev transition, present in 25% of the decays. The beta spectrum of Ms Th 1 is clearly visible but superimposed on the Ms Th 2 Auger L spectrum. (auth)

20965

LOW-ENERGY GAMMA TRANSITIONS IN Eu^{153}. A. Moussa and E. Monnand (Institut de Physique Nucléaire, Lyon). J. phys. radium 21, 463-4(1960) May. (In French)

The internal and external conversion of the low-energy gamma-rays of the $^{99}Mo \rightarrow {}^{99}Tc$ decay was studied with a double-focusing magnetic spectrometer. Internal conversion coefficients of 40 kev and 180 kev transitions have been determined by reference to the known coefficients of the 140 kev transition. The K/L ratios and the conversion coefficients are consistent with the assignments M1 (for 40 kev) and E2 (for 180 kev). (auth)

20966

EXPERIMENTAL STUDY OF THE SPECTRUM OF AUTOIONIZATION ELECTRONS IN β RADIOACTIVITY. F. Suzor (Faculté des Sciences, Orsay, France). J. phys. radium 21, 465-6(1960) May. (In French)

Continuum spectra, between 1 and 13 kv, of autoionization electrons are given for 6 radioelements. A disagreement results from comparison with theory; this could be explained by a more important contribution of the external electronic shells. (auth)

20967

STUDY OF THE GAMMA SPECTRA OF SHORT-PERIOD EMITTERS OF MASS NUMBER NEAR 80. C. Ythier and R. Van Lieshout (Instituut voor Kernphysisch Onderzoek, Amsterdam). J. phys. radium 21, 470-2(1960) May. (In French)

The gamma-ray spectra emitted by 32-sec Cu^{68}, 52-min

As^{70}, 61.5-min Se^{81m} (in equilibrium with 18.2-min Se^{81}), 25-min Se^{83}, and 2.3-h Br^{83} have been measured with scintillation techniques. The sources were produced by fast neutron bombardment or deuteron bombardment in the synchrocyclotron. Various new gamma rays have been found, and coincidence relations have been established between some of them by the method of summing in the cavity of a 2.5 inch crystal. From these studies it follows that Cu^{68} decays certainly through the 2.32-Mev level of Zn^{68} and probably excites additional higher lying levels, that the level scheme of Br^{81} is much more complicated than reported so far and that the 566 kev level in Kr^{83} is also populated in the decay of Br^{83}. A level at 2.71 Mev is found in Br^{83}, which shows properties reminiscent of a collective octupole excitation. (auth)

20968

IDENTIFICATION OF THE GAMMA RAYS OF THE ACTINIUM FAMILY USING A SCINTILLATION SPECTROMETER. G. Walter and A. Coche (Centre d'Recherches Nucléaires, Strasbourg). J. phys. radium 21, 477-9(1960) May. (In French)

Using a scintillation spectrometer, a study was made of the gamma rays of members of the actinium family. Results are presented for Pb^{211} Bi^{211} Ra^{223} Rn^{219} Fr^{223}, and Th^{227}. Particulars of the experimental apparatus are given. (auth)

20969

GAMMA RAYS FROM SEVERAL ELEMENTS BOMBARDED BY 10 AND 14 Mev PROTONS. Tetsuo Wakatsuki, Yasuo Hirao, Eiji Okada, Iwao Miura, Kenzo Sugimoto, and Akira Mizobuchi (Osaka Univ.). J. Phys. Soc. Japan 15, 1141-50(1960) July. (In English)

Gamma ray spectra and intensities from C, O, Mg, Al, Si, Ca, Ti, Cr, Fe, Ni, Cu, Ag, Cd, Sn, Pt, Au, and Pb bombarded by 10 and 14 Mev protons were studied. For C, O, Mg, Si, and Ca, most of the gamma rays could be attributed to the inelastic scattering. New levels at 7.08 and 8.13 Mev are suggested in Ca^{40}. (auth)

20970

ELASTIC AND INELASTIC SCATTERING OF PROTONS FROM NICKEL ISOTOPES; Ni^{58} AND Ni^{60}, IN THE ENERGY RANGE FROM 7.0 Mev TO 15.3 Mev. Shinsaku Kobayashi, Kazuhisa Matsuda, Yukio Nagahara, Yukiyasu Oda, and Nobuhiro Yamamuro (Tokyo Univ.). J. Phys. Soc. Japan 15, 1151-7(1960) July. (In English)

Angular and energy dependence of the elastic and the inelastic scattering of protons from nickel isotopes, Ni^{58} and Ni^{60}, were investigated in the energy range from 7.0 to 15.3 Mev. Angular distributions in the high energy region ($E_p \geq 10$ Mev) showed small differences between both isotopes. Energy dependence of the differential cross sections in the low energy region (7 Mev $< E_p <$ 9 Mev) showed some fluctuations both for the elastic and the inelastic scattering. The inelastic yield for Ni^{58} was larger than that for Ni^{60} in the low energy region ($E_p \leq 9$ Mev). These yields decreased gradually as the incident energy increased. The results are compared with previous values. (auth)

20971

ELASTIC AND INELASTIC SCATTERING OF ALPHA PARTICLES BY CARBON. Takashi Mikumo, Hisashi Yamaguchi, Itaru Nonaka, Masatoshi Odera, Yoshio Hashimoto, Motoo Kondo, and Takashi Maki (Tokyo Univ.). J. Phys. Soc. Japan 15, 1158-63(1960) July. (In English)

Angular distributions of alpha particles scattered elastically and inelastically (Q = −4.43 Mev) by carbon nucleus were measured with incident alpha energies of 28.4, 31.0, and 33.6 Mev. Angular distributions of inelastic alpha groups corresponding to Q = −7.66 and −9.63 Mev and a broad alpha group with Q ≃ 12.7 Mev were also obtained at E_α = 28.4 Mev. The data were compared with Blair's diffraction scattering model and fairly good agreements were obtained for both elastic and inelastic (Q = −4.43 Mev) angular distributions for forward angles for three energies. The rises of cross sections at back angles, however, seemed to occur from other mechanisms. Spin and parity assignments were tried for 7.66 and 9.63 Mev levels of carbon. (auth)

20972

ELASTIC AND INELASTIC SCATTERING OF PROTONS BY OXYGEN IN THE ENERGY REGION OF 6.9 Mev to 15.6 Mev. Shinsaku Kobayashi (Tokyo Univ.). J. Phys. Soc. Japan 15, 1164-74(1960) July. (In English)

Extensive experimental results were obtained, showing the variation with energy of the absolute angular distributions for the elastic and inelastic scattering of medium energy protons on oxygen. For the elastic scattering, angular distributions between 20 and 160° were obtained for twenty incident proton energies spaced between 6.87 and 15.6 Mev. The absolute angular distributions for the inelastic proton groups, leading to the excitation of about 6 Mev (6.06 and 6.14 Mev) and 7 Mev (6.92 and 7.12 Mev) states of O^{16}, were measured at five energies from 11.9 to 15.6 Mev. Although angular distributions varied remarkably with the incident energy, integrated cross section decreased monotonically as incident energy increased. In particular, at E_p = 15.6 Mev the total inelastic scattering cross section was roughly measured to be 240 ± 40 mb. From this result and the reported results for other reaction cross sections, it was deduced that the O^{16} nucleus was considerably transparent even for this rather high incident energy. The excitation function for the elastic scattering showed appreciably sharp resonances at energies, 7.2, 10.6, and 14.7 Mev, and its gross structure had a large scale resonance of a width about 4 Mev, at incident energy of about 13 Mev. It appeared that this resonance was the f-wave giant resonance expected from the shell model. (auth)

20973

LOW-ENERGY PHOTOPRODUCTION OF NEUTRAL MESONS FROM COMPLEX NUCLEI. R. A. Schrack (National Bureau of Standards, Washington, D. C. and Univ. of Maryland, College Park) and S. Penner and J. E. Leiss (National Bureau of Standards, Washington, D. C.). Nuovo cimento (10) 16, 759-61(1960) May 16. (In English)

Angular distribution measurements were made for π^0 photoproduction from C, Al, Cu, Cd, and Pb, using 170-Mev bremsstrahlung and two scintillation counter telescopes. The first peak in the distribution curves is fitted well by a Born approximation derived from electron scattering data, but the second peak does not agree with the approximation, the discrepancy being larger for the lighter elements and ascribed to interaction of the outgoing mesons with the recoil nucleus. An equation for $\sigma(\Theta)$ divided by the Born approximation form factor, $F^2_{Born} \sin^2\Theta$, in terms of A is constructed with an $A^{1.85}$ dependence, in fair agreement with the A^2 dependence predicted by the coherent process and indicating that nuclear absorption of outgoing mesons is small. (D.L.C.)

20974

EVIDENCE FOR A NEW 191 min HALF-PERIOD ACTIVITY IN Nb. M. Bocciolini, G. Di Caporiacco, L. Fòa, and M. Mandò (Istituto Nazionale di Fisica Nucleare, Florence and Università, Florence). Nuovo cimento (10) 16, 780-81 (1960) May 16. (In English)

A new activity of 191-min half life was found when Nb was irradiated with neutrons from $H^3(d,n)He^4$. Its γ spectrum was found to have peaks at 200, 495, and ~930 kev; the last one was identified with the 934-kev ray from 10.15-day Nb^{92} decay. The 200- and 495-kev rays, corrected for the 10.15-day activity, were found to exhibit the same half life, 191 ± 3 min, and to be in coincidence and of the same intensity. From γ spectra comparisons, the ratio of the production cross section for the 191-min activity to that for the 10.15-day activity is computed to be ~0.018. The 191-min activity is assigned to an isomeric state of either Nb^{92m} or Nb^{93m}, the former being more likely, and the 495-kev ray is assumed to precede the 200-kev ray and to be a $\Delta J = 4$ transition, probably a M4 one. (D.L.C.)

20975

THEORY OF NUCLEAR QUADRUPOLE INTERACTION IN BERYLLIUM METAL. M. Pomerantz and T. P. Das (Univ. of California, Berkeley). Phys. Rev. 119, 70-8(1960) July 1.

The theory of the origin of the field gradient at nuclei in metals was analyzed. The contributions of the ion cores and conduction electrons were separately considered. In the case of beryllium metal, using orthogonalized plane wave functions, the conduction electrons are shown to enhance, by about 8%, the field gradient due to the ion cores. Combining the results of the calculations with Knight's experimental value of 48 kc/sec for the Be^9 coupling constant e^2qQ/h, a value of $Q = 0.032 \times 10^{-24}$ cm^2 is obtained. The dependence of the potential for the conduction electrons on the model chosen is analyzed. The various uncertainties in the field-gradient calculation and the theoretical value of the Knight shift in beryllium metal are discussed. (auth)

20976

HYPERFINE STRUCTURE OF THE $6\,^3P_2$ STATE OF $_{80}Hg^{199}$ AND $_{80}Hg^{201}$. PROPERTIES OF METASTABLE STATES OF MERCURY. Mark N. McDermott and William L. Lichten (Columbia Univ., New York). Phys. Rev. 119, 134-43(1960) July 1.

The hyperfine structures of the metastable $6\,^3P_2$ state of Hg^{199} and of Hg^{201} were measured by the atomic-beam magnetic resonance technique. The present experiment is the first one for which the electron bombardment method was used in the production of a narrowly collimated beam of metastable atoms. The beam was detected by surface ejection of electrons from an alkali metal surface. The zero magnetic field intervals $f(F \longleftrightarrow F')$ are: for Hg^{199} $f(\frac{5}{2} \longleftrightarrow \frac{3}{2})$ = 22 666.559(5) Mc/sec; and for Hg^{201} $f(\frac{7}{2} \longleftrightarrow \frac{5}{2})$ = 11 382.6288(8) Mc/sec, $f(\frac{5}{2} \longleftrightarrow \frac{3}{2})$ = 8629.5218(5) Mc/sec, and $f(\frac{3}{2} \longleftrightarrow \frac{1}{2})$ = 5377.4918(20) Mc/sec. The values of the quadrupole and octupole moments of Hg^{201} are, without polarization corrections, $Q = 0.50(4) \times 10^{-24}$ cm^2 and $\Omega = 0.13$ nuclear magneton barn. The hyperfine structure anomaly for the two isotopes due to the s electron alone is $\Delta(s_{1/2}) = -0.1728(12)\%$ in disagreement with the predictions of the single-particle model. The g_J values for the $^3P_2$ state and the $(5d^96s^26p)^3D_3$ state were found to be $g_J(^3P_2) = 1.50099(10)$ and $g_J(^3D_3) = 1.0867(5)$. The value of J = 3 for the $^3D_3$ state was confirmed. A new technique for obtaining excitation functions is discussed. (auth)

20977

BORN CROSS SECTIONS FOR INELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOMS. I. 3s, 3p, 3d STATES. Gerard C. McCoyd, S. N. Milford, and John J. Wahl (St. John's Univ., Jamaica, N. Y.). Phys. Rev. 119, 149-53(1960) July 1.

Born cross sections of all n = 3 to n = 4 transitions are calculated at ten incident electron energy values at 0.67 to 1400 ev, and those of strong optically allowed n = 3 to n = 5 transitions are calculated at five incident electron energy values at 1 to 10,000 ev. The cross sections obtained are much larger than for comparable transitions from the ground state, and the cross sections for transitions which are optically allowed and in which n and l change in the same sense are larger than those for other transitions. For all strong optically allowed transitions the Bethe (dipole) approximations to the Born cross sections are calculated and comparison shows that the Bethe formula gives a good fit to the Born approximation down to relatively low energies (≈10 ev). (auth)

20978

BORN CROSS SECTIONS FOR INELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOMS. II. 4s, 4p, 4d, 4f STATES. Leonard Fisher, S. N. Milford, and Frank R. Pomilla (St. John's Univ., Jamaica, N. Y.). Phys. Rev. 119, 153-5(1960) July 1.

The Born total cross sections are calculated for the inelastic scattering of electrons by hydrogen atoms for the strong optically allowed transitions from n = 4 to n′ = 5. The nine incident energies considered are 0.546 ev to 1361 ev. In addition, the 4s to 6p and 4f to 6g transitions are considered. Bethe (multipole) cross sections are calculated and found to reproduce the Born results down to low energies. (auth)

20979

UPPER BOUNDS ON ELECTRON-ATOMIC HYDROGEN SCATTERING LENGTHS. Leonard Rosenberg, Larry Spruch, and Thomas F. O'Malley (New York Univ., New York). Phys. Rev. 119, 164-70(1960) July 1.

Recently developed variational techniques for determining upper bounds on scattering lengths are applied to singlet and triplet scattering of zero-energy electrons by atomic hydrogen. The results obtained are not only rigorous but are in fact somewhat lower and therefore somewhat better than those previously obtained by variational methods. It was found that the triplet and singlet scattering lengths, A_T and A_S, respectively, satisfy the inequalities $A_T \leqq 1.91a_0$ and $A_S \leqq 6.23a_0$, where a_0 is the Bohr radius. The only assumptions involved in the deduction of these results are that there be no bound triplet state and only one bound singlet state. The singlet trial function determined during the course of the calculation generates a singlet effective range, r_{0S}, of about $2.7a_0$. The triplet trial functions which were obtained were not sufficiently accurate to be useful in a determination of the triplet effective range, r_{0T}. (auth)

20980

DEPENDENCE OF THE In^{116} ACTIVATION RATIO ON NEUTRON ENERGY. Fahri Domanic and Vance L. Sailor (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 119, 208-12(1960) July 1.

Indium was irradiated with monochromatic neutrons of various energies, and a measurement was made of the ratio of the 54-minute to the 13-second activities of In^{116} produced by neutron capture in In^{115}. Such a ratio expresses the relative probability for populating the ground or the isomeric state from the initial compound state. The irradiations were made with monochromatic neutrons from a crystal spectrometer at the resonance energies 1.456 and 3.86 ev, in regions between resonances at 0.1 and 2.66 ev, and with "pile neutrons." The results show that the activation ratio differs for the two resonances by a factor of approximately 3.5, with relatively more of the 13-second activity being associated with the 3.86-ev resonance. The

half-lives of the two In^{116} activities were redetermined and the values 13.4 ± 0.4 seconds and 53.9 ± 0.2 minutes were obtained. (auth)

20981

THEORETICAL PREDICTIONS FOR THE SPECTRA OF THE ODD-MASS XENON AND TELLURIUM ISOTOPES. Norman K. Glendenning (Univ. of California, Berkeley). Phys. Rev. 119, 213-17(1960) July 1.

The spectra of the isotopes $Te^{123,125}$, $Xe^{127,129}$ are calculated by assuming that the odd neutron, having available the $3s_{1/2}$ and $2d_{1/2}$ states, is coupled to collective surface vibrations of the core. Good agreement is obtained with the known levels in these nuclei using a reasonable value for the coupling parameter. To obtain the agreement, the $d_{1/2}-s_{1/2}$ splitting, ϵ, must be regarded as a function of neutron number. The manner in which ϵ varies, as found in the intermediate coupling calculation is compared with the predictions of the pairing correlation theory originally introduced in connection with superconductivity. Agreement as to the general trend is found. This may be regarded to some extent as an indication of the applicability of the pairing correlation theory to nuclear structure calculations. (auth)

20982

RECOIL STUDIES OF HEAVY ELEMENT NUCLEAR REACTIONS. [PART] I. Paul F. Donovan, B. G. Harvey, and W. H. Wade (Univ. of California, Berkeley). Phys. Rev. 119, 218-25(1960) July 1.

Techniques were developed which permit the accurate measurement of angular distributions of recoil nuclei formed in nuclear reactions. The angular distributions of recoils from the reactions $Bi^{209}(\alpha,3n)At^{210}$, $Bi^{209}(\alpha,4n)At^{209}$, and $Bi^{209}(d,3n)Po^{208}$ are consistent with a reaction mechanism involving the formation of a compound nucleus and subsequent isotropic evaporation of the neutrons, as shown by comparison with Monte Carlo calculations based on an isotropic evaporation model. (auth)

20983

RECOIL STUDIES OF HEAVY ELEMENT NUCLEAR REACTIONS. [PART] II. B. G. Harvey, W. H. Wade, and Paul F. Donovan (Univ. of California, Berkeley). Phys. Rev. 119, 225-9(1960) July 1.

Angular distributions and ranges of recoils from the reactions $Bi^{209}(\alpha,2n)At^{211}$ and $Cm^{244}(\alpha,2n)Cf^{246}$ were measured. At helium ion energies higher than about 10 Mev above the Q values of these reactions, the results are consistent with a reaction mechanism involving the emission of one or both neutrons in the forward hemisphere. (auth)

20984

PERTURBATION THEORY APPLIED TO THE NUCLEAR MANY-BODY PROBLEM. J. S. Levinger, M. Razavy, O. Rojo, and N. Webre (Louisiana State Univ., Baton Rouge). Phys. Rev. 119, 230-40(1960) July 1.

Perturbation theory is applied to infinite nuclear matter at the observed density for a well-behaved two-body potential, containing a tensor force. It was found that a tensor force can contribute as much as 10 Mev/particle to the binding energy in second order. Perturbation theory is then modified to include the pseudopotential treatment of an infinite repulsive core. A derivation is given of the DeDominicis-Martin and Huang-Yang result for a pure repulsive core. An expansion was obtained jointly in powers of the strength of the attractive potential, and in the range of the core. The second-order contributions to the binding energy were found for several potentials combining an infinite repulsive core with an attractive potential. For each case considered, the second-order terms are large (absolute value about 20 Mev/particle). (auth)

20985

TWO-NUCLEON STRIPPING PROCESS. M. el Nadi (Yale Univ., New Haven). Phys. Rev. 119, 242-7(1960) July 1.

A new expression is derived for the differential cross section of processes in which two nucleons are captured from an incident alpha particle or similar projectiles. The formula derived is compared with a similar one previously obtained together with some experimental data on the $O^{16}(d,\alpha)N^{14}$ reaction. Fairly good agreement is observed. (auth)

20986

STRIPPING MECHANISM FOR REACTIONS WITH SMALL Q VALUE: THE REACTION $Li^7(d,p)Li^8$. J. P. F. Sellschop (Univ. of Witwatersrand, Johannesburg, South Africa). Phys. Rev. 119, 251-8(1960) July 1.

A number of angular distributions of protons from the reaction $Li^7(d,p)Li^8$ were measured for a range of incident deuteron energies below 2.5 Mev. These agree remarkably well with a simple form of Butler-Born stripping theory, uncorrected for Coulomb and nuclear effects. A description is given for this unusual agreement in terms of the small Q value, −0.188 Mev, for the reaction. A resonance in the proton yield is found at an incident deuteron energy of 1.4 Mev which was not observed in measurements of the β yield from this reaction. Angular distributions measured on and around the resonance show no influence of this on the unusually good stripping patterns. (auth)

20987

RADIOACTIVE DECAY OF Tm^{166}. R. G. Wilson and M. L. Pool (Ohio State Univ., Columbus). Phys. Rev. 119, 262-6 (1960) July 1.

Erbium oxide enriched to 72.9% in the 166 mass number was irradiated with 6-Mev protons. An activity decaying by electron capture and positron emission with a half-life of 7.69 ± 0.05 hours was produced by a (p,n) reaction and its assignment to Tm^{166} confirmed. The observed activity consists of the K x-ray of erbium, gamma rays with energies of 81, 184, 289, 405, 460, 598, 674, 694, 707, 759, 782, 788, 878, 1052, 1179, 1276, 1351, 1589, 1874, and 2058 kev, annihilation radiation, and particle radiation with an end-point energy of 2090 ± 40 kev. Gamma-gamma coincidence measurements and consideration of the energies and relative numbers of the observed radiations led to the assignment or confirmation of energy levels at 81 (2+), 265 (4+), 554 (6+), 788 (2+), 863 (3+), 959 (4+), 1248 (2), 1317 (5), 1462 (0+), 1547 (3+), 1701 (4+), 1894 (5+), 2139 (3), and 2168 (0) kev in Er^{166}. The 2139-kev level is highly populated by electron capture and the positron transitions occur to the 265 (4+)-kev level. The positions of the observed radiations and the branching ratios of electron capture are shown in a proposed energy level scheme. (auth)

20988

ELASTIC SCATTERING OF DEUTERONS BY He^4. J. L. Gammel, B. J. Hill, and R. M. Thaler (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 119, 267-71(1960) July 1.

A model of the d + He^4 interaction is developed and compared to the data on the ground state of Li^6 and the d + He^4 elastic scattering data to 4.5 Mev (deuteron laboratory energy). New phase-shift analyses of the 8- and 10.3-Mev elastic scattering data are made, and quantities relevant to the production or analysis of beams of polarized deuterons are calculated. (auth)

20989

BRANCHING OF TRANSITIONS IN SOME MIRROR NUCLEI.

W. L. Talbert, Jr. and M. G. Stewart (Ames Lab., Ames, Iowa). Phys. Rev. 119, 272-6(1960) July 1.

The possibility of branching in the decays of Na^{21}, Mg^{23}, Al^{25}, Si^{27}, S^{31}, and Ca^{39} was investigated using NaI(Tl) scintillation detectors. The nuclear gamma rays emitted as a result of branching transitions were detected in coincidence with the accompanying positron annihilation radiation. Branching was found to the first excited states of the daughter nuclei in the decays of Na^{21}, Mg^{23}, and S^{31}, with intensities (compared to the total decay) of 2.2, 9.1, and 1.1%, respectively. The decays of Al^{25}, Si^{27}, and Ca^{39} were found to have no detectable branching to the lower excited states of the daughter nuclei, and upper limits of less than one per cent were placed on the branching ratios for such branches. The lack of branching in the decay of Al^{25} to the 0.98-Mev level of Mg^{25} favors a unified model description for the nuclear states involved. (auth)

20990

DECAY OF Ga^{66} AND Cu^{66}. Arthur Schwarzschild and Lee Grodzins (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 119, 276-86(1960) July 1.

The 9.5-hour decay of Ga^{66} and the 5.1-minute decay of Cu^{66} were studied by a variety of techniques including gamma-ray spectroscopy, internal conversion measurements, and angular correlation studies. All but one of the 18 gamma rays observed were ordered into a structure of 11 levels and the spins and parities of all but one of these levels were determined. It is shown that Ga^{66} has spin zero and even parity and that its 4.166-Mev β spectrum is a pure Fermi transition. The energy of the internal conversion line of the 4.300 ± 0.005 Mev transition was measured with great care and this line may be useful for spectrometer calibration. The second excited state of Zn^{66}, at 1.875 Mev, has 2+ spin and parity. The stopover transition from this state contains at least 10% M1 radiation: the stopover to crossover ratio is greater than 100 to 1. (auth)

20991

ACCURATE METHOD FOR MEASURING INTERNAL CONVERSION COEFFICIENTS. D. C. Lu (Ames Lab., Ames, Iowa). Phys. Rev. 119, 286-8(1960) July 1.

To reveal the effect on internal conversion due to the nuclear structure and extension, measurements are needed which have higher accuracy than is attainable from currently used methods. A description is given of how, under certain conditions, the absolute value of the total internal conversion coefficient can be measured to ±0.5% by the use of a large NaI(Tl) detector with a thin well-type window. Complications encountered in the comparison between experimental and computed values are mentioned. (auth)

20992

GAMMA RADIATIONS OF Na^{23} AND Ne^{20}. T. H. Kruse, R. D. Bent, and L. J. Lidofsky (Columbia Univ., New York). Phys. Rev. 119, 289-304(1960) July 1.

Na^{23} and Ne^{20} gamma rays were observed from the proton bombardment at various energies of thin evaporated Na and NaI targets and of a natural Ne gas target. Gamma rays involving Na^{23} states to 4 Mev and Ne^{20} states to 5 Mev were observed and decay schemes and branching ratios obtained. The 2.08- and 2.70-Mev states of Na^{23} are probably $7/2^+$ and $9/2^+$, respectively. Limitations on spin and parity values are given for other states. The results obtained for Na^{23} are consistent with the results of a strong-coupling collective calculation. The 4.97-Mev state of Ne^{20} has an upper limit for the ground-state branch of 4%. An upper limit of 9% is placed on the ground-state branch of the 4.2-Mev state of Ne^{20}. Gamma rays from the $F^{19}(d,n\gamma)Ne^{20}$ reaction were observed with energies of 11.4, 10.67, 10.16, 9.37, 8.37, and 7.36 Mev. (auth)

20993

BETA-DECAY THEORY AND THE SPECTRUM OF Rb^{87}. M. A. Preston, G. H. Keech, and J. M. Pearson (McMaster Univ., Hamilton, Ont.). Phys. Rev. 119, 305-10(1960) July 1.

The shape of the third forbidden β spectrum of Rb^{87} was analyzed. It was found to be consistent with a mixture of vector and axial vector interactions, the same value and sign of the ratio g_A/g_V as found for the neutron, and a shell model evaluation of the nuclear matrix elements. (auth)

20994

EXCITATION FUNCTION FOR $Zn^{64}(n,2n)Zn^{63}$. D. R. Koehler and W. L. Alford (Army Rocket and Guided Missile Agency, Redstone Arsenal, Ala.). Phys. Rev. 119, 311-12 (1960) July 1.

The excitation function for $Zn^{64}(n,2n)Zn^{63}$ was measured for neutron energies of 12.2 to 18.1 Mev by an activation method. An absolute cross section was obtained by using the previously measured value of 167 ± 11 mb at 14.4 Mev. Above threshold, the cross section is found to increase rapidly with neutron energy reaching a value of 337 mb at 18.1 Mev. A cross section curve computed on the basis of statistical theory is shown for comparison. (auth)

20995

PROTON-PROTON SCATTERING AT 68 Mev. D. E. Young and L. H. Johnston (Univ. of Minnesota, Minneapolis). Phys. Rev. 119, 313-15(1960) July 1.

Differential cross sections were measured for the scattering of 68.3-Mev protons by hydrogen gas at 26 laboratory angles from 5 to 50°. The angular resolution is ±½° at small angles, and the estimated absolute probable errors are ±0.9% except at the smallest angles. The interference minimum of 5.19 millibarns occurs at 16.3° c.m. The cross section then rises to a maximum of 6.33 mb at 34° and falls to 6.16 mb at 90°. (auth)

20996

NUCLEAR REACTIONS OF LOW-Z ELEMENTS WITH 5.7-Bev PROTONS. Paul A. Benioff (Univ. of California, Berkeley). Phys. Rev. 119, 316-24(1960) July 1.

The results of 5.7-Bev proton bombardments of the target elements Be, C, N, O, F, Na, and Al are described. Production cross sections were obtained for many radioactive products with half-lives of 1.2 minutes to 2.6 years. The (p,pn) cross sections for the targets C, N, O, F, and Na were found to be 29 ± 3, 7.3 ± 0.7, 33 ± 5, 19 ± 2, and 31 ± 5 mb, respectively. Much of the variation in these values is thought to be due to the difference in the number of neutrons available for (p,pn) reactions in the different target nuclei. The cross sections for other types of reactions studied do not change as much over the above range of target elements as do the (p,pn) cross sections. Comparison of these cross sections with those obtained at 0.98 to 3 Bev shows that in the 1- to 5.7-Bev energy range the excitation functions are nearly constant. (auth)

20997

NUCLEAR STRUCTURE AND SIMPLE NUCLEAR REACTIONS. Paul A. Benioff (Univ. of California, Berkeley). Phys. Rev. 119, 324-47(1960) July 1.

Recently it has become increasingly evident that some assumptions in the nuclear model used for the Monte Carlo calculations yield cross section values which are not in accord with experiment. In particular, calculations of (p,pn)-reaction cross sections in the Bev energy range

give values which are low by factors of two to nine when compared to experimental values. The calculated cross sections show a smooth variation with the target atomic weight whereas the experimental values show quite an erratic variation. Reasons which were advanced to account for this lack of agreement are the lack of a nuclear surface and failure to account for shell effects in the nuclear model used. A theory is developed to take account of surface and shell effects and thereby describe the observed magnitude and variation of the cross sections for simple nuclear reactions as exemplified by the (p,pn) reaction. At multi-Bev energies to which this treatment is restricted, the main contribution to the (p,pn)-reaction cross section comes from inelastic collisions between the incident protons and target neutrons, with all the p-n collision products escaping without further interaction. Approximations and assumptions used include the impulse approximation, 0° lab scattering angle for the inelastic p-n collision products, classical trajectories for the incident and scattered particles, and a quantum-mechanical treatment for the target nucleons. The multi-Bev, n-p, cloud-chamber data was used to determine the average total exit cross section for the inelastically scattered particles. The only neutron shells in the target nucleus contributing to the (p,pn) reaction are those for which the instantaneous knocking out of a neutron creates a product-neutron hole state stable to particle emission. The combination of these assumptions gives integral expressions which, when evaluated on the IBM-701 computer for the independent particle harmonic-oscillator shell model, give the (p,pn) reaction cross sections as a function of the nuclear density distribution and the number of available shells. For the low Z nuclei where the available shells can be unambiguously determined, the results give a half-central-density radius parameter, r_0, ($r_0 = R_{1/2}/A^{1/3}$), of about 1.2 fermis compared to 1.03 fermis for the charge half radius from the electron-scattering work. Use of reasonable limits on the value of r_0 allows one to set the minimum number of shells available for some targets. For example, the Zn^{64}, Cu^{65}, and Cu^{63} (p,pn) cross sections require that a large part or all the $1f_{7/2}$ neutrons be available, or, equivalently, that a $1f_{7/2}$ neutron hole state (across a major shell) in the product nucleus have less than 8- to 9-Mev excitation energy. The results show that the energy associated with nuclear rearrangement to particle-stable product states must be less than 8 to 9 Mev. In several cases, the upper limit can be lowered considerably (to 1.5 Mev and 0 Mev in the cases of O^{16} and N^{14}, respectively). (auth)

20998

DEPENDENCE ON ATOMIC NUMBER OF THE NUCLEAR PHOTOEFFECT AT HIGH ENERGIES. P. C. Stein, A. C. Odian, A. Wattenberg, and R. Weinstein (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 119, 348-51(1960) July 1.

A measurement was made of the number of neutron-proton coincidences observed when 320-Mev bremsstrahlung bombarded D, Li, Be, C, O, Al, Ti, Cu, Sn, and Pb. If the data for the number of neutron-proton pairs in a nucleus (i.e., by dividing by NZ/A) is normalized, it is found that the observed coincidences decrease as A increases. It is possible to quantitatively account for this A dependence by correcting for the probability that two nucleons will escape from inside a nucleus without either having a collision. The probability of escape is a function of the nuclear radius, R, and the mean free path, λ, in nuclear matter. For medium weight elements the observed neutron-proton pairs are produced with a cross section given by $\sigma_{Z,A}(\text{coincidences}) \cong 3.0(NZ/A)\sigma_D P(2R/\lambda)$, where σ_D is the cross section for the photodisintegration of the deuteron and where $P(2R/\lambda)$ is the probability-of-escape factor. For two nucleons emitted at 180°, the form of P(x) is $P(x) = (3/x^3)[2 - e^{-x}(x^2 + 2x + 2)]$. The formula for the cross sections is shown to be what would be expected if the fundamental mechanism in complex nuclei is the same as that suggested by Wilson for the photodisintegration of the deuteron. The constant, 3.0, depends on the cube of a neutron-proton pair interaction distance. A less naive treatment involves a nucleon pair correlation function. (auth)

20999

YIELD OF NEUTRONS PER INTERACTION IN U, Pb, W, AND Sn BY PROTONS OF SIX ENERGIES BETWEEN 250 AND 900 Mev SELECTED FROM COSMIC RADIATION. M. Bercovitch, H. Carmichael, G. C. Hanna, and E. P. Hincks (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. 119, 412-31(1960) July 1.

The production of low-energy neutrons in U, Pb, W, and Sn by protons of six selected energies between 250 and 900 Mev was measured using cosmic radiation as a proton source. The protons were selected and their energy measured by a vertical counter telescope containing three Cherenkov detectors which employed liquid nitrogen, water, and Plexiglas as radiating media. The protons interacted in 22 and 44 g cm^{-2} thick slabs of the target elements, and the neutrons produced were detected in a 4-foot cubic paraffin moderator, $B^{10}F_3$ counter assembly placed below the proton selecting telescope. The principal body of data was obtained at 3260 m altitude; a series of runs at 150 m was made to check the high-altitude data for muon contamination of the selected protons. The proton-gated neutron rates for the various targets were converted to mean neutron multiplicities per interaction using (a) the efficiency of the neutron detector as measured using calibrated Pu^{240} spontaneous fission and Ra-α-Be neutron sources (b) the interaction cross sections of Chen, Leavitt, and Shapiro. The mean multiplicities per interaction range from 5.8 ± 1.0 for 300-Mev protons on 33 g cm^{-2} thick Sn, to 26.7 ± 4.2 for 820-Mev protons on 44 g cm^{-2} thick U. The multiplicities predicted from the Monte Carlo nucleon cascade calculation of Metropolis et al. and the Monte Carlo evaporation calculation of Dostrovsky et al. are in agreement with the measurements when secondary neutron production in the thick targets is taken into account. (auth)

21000

THEORY OF ALLOWED AND FORBIDDEN TRANSITIONS IN MUON CAPTURE REACTIONS. [PART] II. Masato Morita and Daniel Greenberg (Columbia Univ., New York). Phys. Rev. 119, 435-7(1960) July 1.

The general formalism in muon capture reactions is applied to the calculation of the angular distribution of the recoils in muon capture. Only the unique nth forbidden transitions [spin change 0 → J, parity change $(-)^{J+1}$] are considered. As an example the special case of C^{12} is discussed. The angular distribution of the recoils depends strongly on the strength of the induced pseudoscalar interaction, but is rather insensitive to the assumption of conserved vector current. (auth)

21001

REGULARITIES OF (d,α) REACTIONS IN HEAVY ELEMENTS. J. B. Mead and B. L. Cohen (Univ. of Pittsburgh). Phys. Rev. Letters 5, 105-7(1960) Aug. 1.

Preliminary results are presented for the reactions (d,α) of heavy elements ($28 \leq Z \leq 82$) with an incident deuteron energy of 15 Mev. Data are plotted on energy

distribution graphs for the alpha scattering angle of 90°, and the following peak characteristics are apparent: (1) the intensity increases with atomic number, and (2) a high-energy peak appears, becoming larger than the low-energy peak for Z > 52. The peak energies of both peaks are compared with the ground state transitions; the ground states appear to be weakly excited for all nuclei investigated. Variations in the energy distribution with the scattering angle are plotted for Au, Sn, Rh, and Ni; there is no shift in peak energy. The low-energy group is interpreted as being due to α particles evaporating from a compound nucleus, but the high-energy group cannot be explained easily on the basis of either a pickup or a knockout process. (D.L.C.)

21002

MOMENTUM DISTRIBUTION OF PROTONS IN INDIVIDUAL NUCLEAR SHELLS. Peter Hillman, H. Tyren, and Th. A. J. Maris (Gustaf Werner Inst., Uppsala). Phys. Rev. Letters 5, 107-8(1960) Aug. 1.

Measurements were made of the angular correlations in $Li^7(p,2p)$ reaction at 180 Mev bombarding energy in which the product protons emerge at equal angles and energies, in order to test the model of the reaction which ascribes the peaks to the $p_{\frac{3}{2}}$ proton and the two $s_{\frac{1}{2}}$ protons in Li^7. The results, plotted on a peak area vs Θ graph, show a maximum for one curve and a minimum for the other, both near $\Theta = 90°$, thus confirming the model. (D.L.C.)

21003

CONTRIBUTION FROM THE THREE-PION STATE TO THE AXIAL VECTOR COUPLING CONSTANT IN β-DECAY. Yasunori Fujii (Nihon Univ., Tokyo) and Susumu Furuichi (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto) 23, 251-72(1960) Feb. (In English)

The effect of the pion cloud to the ratio g_A/g_V in the β decay is investigated with the assumption of the conserved current for the vector interaction. The three-pion state is considered as the simplest state which might improve the result of the static theory, which gives $g_A/g_V < 1$. According to the lowest order perturbation calculation, the contribution from this state turns out to be of the positive sign and large. It seems promising to explain the observed ratio $g_A/g_V > 1$ even when the decrease of the bare state probability is taken into account, unless the effect of the suppression of the nucleon pair is too strong. (auth)

21004

EFFECTS OF THE WEAK INTERACTION ON THE HYDROGEN ENERGY LEVELS. Shigeo Goto and Shigeru Machida (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto) 23, 372-4(1960) Feb. (In English)

The energy levels of H_2 were examined in order to estimate where the effects of weak interactions may be expected to be large. The calculation was done by the covariant lowest order perturbation with the V-A type of the β decay interaction, introducing the cutoff momentum K, neglecting the total energy momentum compared with K, and retaining only the term of highest power of K. It is concluded that weak interactions may give observable contributions to strong interactions at $r_0 = 10^{-17}$ cm. (D.L.C.)

21005

ON THE COLLECTIVE EXCITATION OF SPHERICAL NUCLEI. Minoru Kobayasi and Toshio Marumori (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 387-9(1960) Feb. (In English)

The eigenvalue for collective excitations (vibrations) in spherical nuclei caused by the pairing interaction of the particles in the outermost partly filled shell is deduced with the j-j coupling shell model and without the adiabatic approximation such as that used by Belyaev. The result is identical with that of Belyaev, and the conditions for the stability of spherical nuclei are discussed. (D.L.C.)

21006

FORMULAS IN THE FERMI THEORY OF BETA DECAY. II. ON THE BETA RAY ANGULAR CORRELATION. Zyun-itiro Matumoto (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 531-61(1960) Apr. (In English)

Formulas are given for the allowed and the first forbidden beta-gamma angular correlations including polarization of the gamma ray and the second forbidden beta-gamma directional correlation, where the mixed interaction of vector and axial vector types and the non-conservation of parity in beta decay are assumed. These formulas for the allowed and the first forbidden transitions were already given by Morita and Morita for the case of the point nuclear charge. The final formulas can be expressed in forms similar to the expressions for light nuclei in the usual formulations. The deviations of the coefficients from the usual ones are graphically shown as functions of beta ray energies for Z = ±10, ±30, ±50, ±70, and ±90 (for β^- decay), and significant deviations are found for heavy nuclei except for the allowed transition. Those are especially significant for the nonunique first forbidden, and the unique first and second forbidden transitions (several ten percents for Z ~ 90). One of the important results is that the theory is again insensitive to the nuclear charge distributions. (auth)

21007

SURFACE DIFFUSENESS AND PHENOMENOLOGICAL TREATMENT OF O^{17} NUCLEUS. Yoshimi Akiyama (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 903-14(1960) May. (In English)

The effects of surface diffuseness on the single particle level structure and wave functions are investigated in a pure single particle model. It is shown that the ground state and the first excited state of O^{17}, which are interpreted as giving $1d_{\frac{5}{2}}$ and $2s_{\frac{1}{2}}$ shell levels, respectively, and low energy elastic scattering of neutrons by O^{16} can be well reproduced by a diffuse potential well. In particular, it is pointed out that the relative location of $2s_{\frac{1}{2}}$ and $1d_{\frac{5}{2}}$ levels depends sensitively on finer details of the surface diffuseness. The modifications of the single particle wave functions from pure harmonic oscillator functions are further investigated, and they are found to be small up to 1p states, but for higher states they may be so large that with pure oscillator functions one cannot hope to make quantitative discussions when treating near A = 16 nuclei. (auth)

21008

UNTERSUCHUNG DER OPTISCHEN HYPERFEINSTRUKTUR UND VERSCHIEDENER KERNEIGENSCHAFTEN DER STABILEN EUROPIUM-ISOTOPE. (Research on the Optical Hyperfine Structure and Different Nuclear Properties of Stable Europium Isotopes). Roland Winkler. Thesis, Berlin, Technische Universitat, 1959. 137p.

The hyperfine structure absorption spectral lines of Eu^{151} and Eu^{153} were produced with a Fabry-Perot interferometer. To obtain hypothesis-free results, a special evaluation process was devised. Thus, in a specially adapted balancing calculation for re-determined equation systems, all splitting factors which are concerned with a line are treated simultaneously from the single components of this line. Also a simple graphic method is given for determination of splitting factors from position measurements. (tr-auth)

Particle Accelerators

21009 CEA-1448

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay; France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble; and Grenoble, France. Université. Laboratoire de Physique Nucléaire.

OPTIQUE D'UN SECTEUR MAGNETIQUE A DOUBLE FOCALISATION PAR EFFET DE FRANGES. (Optics of a Double Focussing Magnetic Sector by Fringe Effect). J. Krafft. 1960. 31p.

A general study is made of the optical elements of a double-focusing magnetic sector by the fringe effect, with a view to its application to the monochromation of the proton, deuteron, or triton beam of the 1.4 Mev accelerator. (auth)

21010 ORO-302

Virginia. Univ., Charlottesville.

RESEARCH STUDIES WITH A 1-Mev VAN de GRAAFF MACHINE. Annual Report. Frank L. Hereford. June 1960. 16p. Contracts AT(40-1)-1754 and DA-36-034-ORD-2046. OTS.

Information is contained on research studies with a 1-Mev Van de Graaff machine. Activities are summarized in terms of elastic scattering of 3.4-Mev polarized neutrons, precession of 3.4-Mev polarized neutrons in magnetized iron, and development and use of a mμsec neutron time-of-flight spectrometer. (W.D.M.)

21011 TID-6176

[Midwestern Universities Research Assn., Madison, Wis.]. MINUTES OF THE MURA GENERAL CONFERENCE, MADISON, WISCONSIN, JANUARY 8-9, 1960. 21p. OTS.

Design parameters of a spiral sector proton accelerator with beam intensity of ~50 μ amp and energy of ~10 Bev are given. The calculation of magnetic field patterns from given configurations of iron and current by scalar functions is demonstrated for three dimensional current distributions. Radiation effects upon materials near high-energy accelerators is reviewed. Nuclear parameters of an injector capable of obtaining a beam of 30 μ amps are given. A method of producing high magnetic fields by mechanically "squeezing" a pre-existing, relatively small field between two (or more) conductors is described. Progress on the Michigan State University Cyclotron Project and the construction of the Illinois Spiral Ridge Cyclotron is reported. (W.D.M.)

21012 UCRL-5463-T

California. Univ., Livermore. Lawrence Radiation Lab. HIGH CURRENT ELECTRON ACCELERATOR. N. Christofilos. Jan. 22, 1959. Changed from OFFICIAL USE ONLY Feb. 15, 1960. 23p. OTS.

Microwave and H.F. electron acceleration were investigated within unloaded cavities excited in TM modes; the phase velocity is slightly higher than the light velocity; the length of the cavity is limited by the phase lag resulting from the difference of wave and electron velocity. The region of beam current of interest is in the vicinity of 100 amps. Beam diameter of the order of 10 cm is assumed to avoid excessive divergence from the self-field forces. The cavity diameter required is 2 to 4 ft for microwave and 20 ft for H.F. acceleration. The excited mode is standing wave; one of the two traveling waves is then employed for the acceleration. The skin losses are more than ten times higher than the Stanford type accelerator. These losses are acceptable as they are small in comparison with the beam power. However, together with the high skin losses there is large stored energy; hence frequency shift due to the beam loading is very small. Focussing of the beam is provided by R.F. strong focussing. The accelerating cavity is excited simultaneously in a second TM mode of infinite phase velocity. The azimuthal magnetic field of this mode provides the alternating gradient field. This combination secures a good quality of the electron beam, thus affording microwave or H.F. acceleration of electrons even in cases, as the Astron device, where extreme quality of the electron beam is required. (auth)

21013 UCRL-5951-T

California. Univ., Livermore. Lawrence Radiation Lab. HIGH CURRENT PULSED ELECTRON ACCELERATOR. N. Christofilos. June 28, 1960. 5p. Contract [W-7405-eng-48]. OTS.

Presented at the APS Meeting, Montreal, Canada, June 15-17, 1960.

The operation principle of the Astron electron accelerator is an accelerating induction electric field generated by changing the magnetic flux in a ferromagnetic material. The accelerator consists of a number of identical modular units. Each unit is cavity loaded with a ring-shaped laminated silicon steel core. The primary winding is connected to a pulse-forming network through a high current switch. Hydrogen thyratrons are used for the switching gear. (W.D.M.)

21014 UCRL-9220

California. Univ., Berkeley. Lawrence Radiation Lab. BEVATRON OPERATION AND DEVELOPMENT. XXIV. [Period covered] November, December 1959, January 1960. Walter D. Hartsough. May 25, 1960. 14p. Contract W-7405-eng-48. OTS.

Study of particle interactions was continued. Bubble chambers, counting systems, and nuclear emulsions were used to investigate the interactions of $\pi^{\pm}$, μ^{-}, and K^{+} mesons. Nuclear emulsion stacks were exposed for ten outside groups—five exposures to a π^{-} beam and five to a K^{+} beam. (For preceding period see UCRL-9058.) (auth)

21015

EXTRACTION AND ANALYSIS OF THE BEAM OF THE LOUVAIN CYCLOTRON. A. Gonze, R. Keppenne, and P. C. Macq (Centre de Physique Nucléaire, Louvain, Belg.). Ann. soc. sci. Bruxelles. Sér. I 74, 140-55 (1960) June. (In French)

The various steps in the extraction and analysis of the beam of the Louvain cyclotron are described. Two beams are available, one direct beam of 12.2-Mev deuterons and one deflected beam of 24-Mev α particles. (tr-auth)

21016

PROBLEMS OF PROTECTION AGAINST RADIATIONS NEAR ACCELERATORS. P. Candes (Centre d'Études Nucléaires, Saclay, France). Bull. inform. sci. et tech. (Paris) No. 39, 35-42(1960) Apr. (In French)

The calculation of shielding in accelerators depends on the radiation sources and on the nature of the radiation emitted. The diversity of the problems posed by accelerator shielding such as radiation detection, examination of different zones having irradiation hazards, and monitoring devices are reviewed. (J.S.R.)

21017

PHASE OSCILLATIONS IN HIGH CURRENT SYNCHROTRONS. Irvin G. Henry (Hughes Aircraft Co., Culver City, Calif.). J. Appl. Phys. 31, 1338-42(1960) Aug.

The theory of phase oscillations in the synchrotron, first given by Bohm and Foldy, is extended to cover the case where the amplitude of the accelerating voltage is not con-

stant and where the accelerated bunch is itself sufficiently large to produce an appreciable part of the accelerating voltage. It is found that the phase oscillation is more stable when the driving frequency is less than the natural frequency of the accelerating electrode system, and that the plate characteristic of the driving amplifier has a negligible effect on the phase stability. (auth)

21018

157-Mev SYNCHROCYCLOTRON. C. Bergamaschi, J. C. Brun, A. Cabrespine, R. Gayraud, M. Génin, H. Langevin-Joliot, N. Marty, A. Michalowicz, P. Radvanyi, M. Riou, J. Teillac, and C. Victor (Faculté des Sciences, Orsay, France). J. phys. radium 21, 305-14(1960) May. (In French)

The general characteristics of the synchrocyclotron de la Faculté des Sciences (157 Mev protons) and its setting up are described. The main properties of the external proton beam (focusing, energy definition, time structure with or without additional high modulation frequency at the end of acceleration, intensity measurements with ionization chamber and Faraday cup) and of the neutron beam (energy spectrum, intensity) are given. The characteristics of a magnetic analyzer of secondary particles under construction and a summary of the main uses of the machine are also given. (auth)

21019

METHOD OF IMPROVING THE TIME STRUCTURE OF THE EXTERNAL BEAM OF A SYNCHROCYCLOTRON. A. Cabrespine (Faculté des Sciences, Orsay, France). J. phys. radium 21, 332-7(1960) May. (In French)

The object was to modify the time distribution of the synchrocyclotron external beam in order to increase the yield of particle measurement devices. The pulse repetition frequency was raised from 450 per second to 40,000 per second, and there are practically no more dead times. (auth)

21020

RAPID PULSING APPARATUS FOR A LOW-ENERGY ELECTROSTATIC ACCELERATOR. B. Cheynier, J. L. Leroy, and K. Prelec (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 393-6(1960) May. (In French)

The ion beam obtained from a 300 kv Cockcroft-Walton accelerator after magnetic analysis is swept by a transverse radiofrequency electric field. The beam is chopped by a slit placed after the sweeping field. The emerging ion pulse is then bunched by an axial radiofrequency electric field. The ion pulse duration on the target is a few 10^{-9} s for a 6.8 MHz frequency; the mean current on the target is then $\frac{1}{5}$ to $\frac{1}{8}$ of the current without pulsation. (auth)

21021

AN ION SOURCE WHICH PRODUCES He^{++} ION FOR AN ELECTROSTATIC ACCELERATOR. B. Olkowsky (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 407-9(1960) May. (In French)

A Heil-Von Ardenne type ion source was built. When this source was mounted on the high voltage terminal of the 5 Mev Van de Graaff, a 4.8-Mev He^{+} and a 9.6 Mev He^{++} beam was obtained with intensities respectively 25 and 5×10^{-2} μa. The power supplied was 16 watt. (auth)

21022

MULTICHARGED ION SOURCE FOR A CYCLOTRON. A. Papineau, P. Benezech, and R. Maillard (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 410-11(1960) May. (In French)

An ion source with a tungsten cathode indirectly heated by a classical filament was built. The arc voltage is pulsed and the intensity is 40 a. The preliminary tests allow an estimate that an external beam of N^{5+} of about 1 μa can be obtained. (auth)

21023

MAGNETIC ANALYZER OF THE BEAM OF THE 600-kv GRENOBLE ELECTROSTATIC ACCELERATOR. J. E. David, J. Krafft, R. Bouchez, and N. Felici (Centre d'Études Nucléaires, Grenoble, France and Université, Grenoble, France). J. phys. radium 21, 435-9(1960) May. (In French)

The properties of the proton beam from the 600 kv electrostatic accelerator of the University of Grenoble have been determined with a magnetic analyzer. The analyzed beam has an energy definition of a few 10^{-3}; the nuclear reactions $Na^{23}(p,\gamma)$ (308 kev), Al^{72}(438 and 504 kev), Li^{7}(441 kev) have been used to calibrate the accelerator. The $B^{11}(p,\gamma)$ resonance width has been remeasured, giving $\Gamma_r = (5.4 \pm 1)$ kev. (auth)

21024

DESIGNING OF PROTECTION FOR BETATRON WITH ENERGY OUTPUT OF 25 Mev. V. V. Dmokhovskii (State Research Roentgen-Radiological Inst., Ministry of Health, USSR). Med. Radiol. 5, No. 5, 78-84(1960) May. (In Russian)

The selection of protection standards for living quarters and the estimated values of energy and intensity of radiation are described. Inadequate clarity in the problem of biological action of radiation with such high energy made it necessary to introduce a properly substantiated protection safety factor. Following calculations with due account of all factors, a number of graphs were obtained which allow the design of practical protection for the betatron. With the aid of these data, the design of protection against betatron irradiation with different energy outputs may be effected. (auth)

21025

EXTRACTION OF PROTONS FROM THE BIRMINGHAM 1000-Mev SYNCHROTRON. G. A. Doran, E. A. Finlay, H. R. Shaylor, and M. M. Winn (Birmingham Univ., Eng.). Nuclear Instr. & Methods 7, 225-36(1960) June. (In English)

An electromagnetic deflecting channel for protons is described. This channel was moved close to the circulating beam in the synchrotron vacuum box after the beginning of the accelerating cycle. Protons were induced to enter the deflector by Coulomb scattering through a very small angle, and when the current flowing through the deflector was ~35 ka the protons were deflected through an angle ~0.03 radians and escaped from the synchrotron. The number of protons available per pulse in the experimental area was increased by a factor ~1000 from that obtained previously by nuclear scattering from internal targets. (auth)

21026

CYCLOTRON INSTRUMENTATION FOR NUCLEAR REACTION STUDIES BY MAGNETIC ANALYSIS. Bo Sjögren (Nobel Inst. of Physics, Stockholm). Nuclear Instr. & Methods 7, 274-88(1960) June. (In English)

An instrumentation for magnetic analysis work at a small cyclotron (7 Mev deuterons, 14 Mev α-particles) is described. The equipment consists of two quadrupole lenses and an analyzing magnet for the preparation of a beam spot on the target and of a magnetic spectrometer for investigation of the reaction particles. The magnetic analyzers have perpendicular bending planes. Angular distributions can be measured from 0 to 135°. The detectors,

the adjustments, the experimental procedure and the performance of the system are discussed. (auth)

21027

DEPOLARIZATION OF A POLARIZED PROTON BEAM IN A SYNCHROTRON. Marcel Froissart and Raymond Stora (Centre d'Etudes Nucléaires, Saclay, France). Nuclear Instr. & Methods 7, 297-305(1960) June. (In French)

An initially polarized proton beam, when injected in a synchrocyclotron, may suffer substantial depolarization effects, in view of magnetic field inhomogeneities "seen" by individual particles within the beam. A semiquantitative study is made for the 3 Bev Saclay synchrocyclotron. There, the combined effect of vertical betatron oscillations and passage through the straight sections fringing fields is critical. One finds indeed that a certain resonance condition is fulfilled for two values of the energy within the acceleration cycle, which entails a large depolarization in the present case. On the other hand, perturbations due to magnetic inhomogeneities inside the quadrants and the accelerating cavity as well as effects due to synchrotron oscillations prove to be small. It is felt that the analysis presented here could be extended to other machines and other types of accelerated particles. In particular, it is easy to see whether the resonance condition implies the existence of "dangerous" energy regions or not. (auth)

21028

LOW ENERGY PARTICLE ACCELERATORS FOR PRECISION NUCLEAR PHYSICS RESEARCH. Fred L. Niemann (High Voltage Engineering Corp., Burlington, Mass.). Nuclear Instr. & Methods 7, 338-49(1960) June. (In English)

The three types of particle accelerators presently available for precision research in the nuclear binding energy range are positive-ion linear accelerators, azimuthally-varying-field cyclotrons, and multi-stage Van de Graaff accelerators. The state of development of these accelerators is reviewed and their relative advantages and disadvantages are compared on the basis of performance capabilities, approximate costs and availability. (auth)

Plasma Physics and Thermonuclear Processes

21029 AD-231905

Stevens Inst. of Tech., Hoboken, N. J.

INVESTIGATION OF PLASMA ACCELERATION. MEGATRON ACCELERATOR PROGRESS REPORT. Quarterly Progress Report No. 5 [for] July 1, 1959–September 31, 1959. K. C. Rogers, G. Brucker, L. Ferrari, I. Mansfield, and D. Caulfield. 21p. Sponsored by U. S. Atomic Energy Commission and Army Signal Supply Agency under Contract DA 36-039SC-78097. OTS.

The closing delay time of high-current (plasma) vacuum-gap switches used in conjunction with the Megatron accelerator and fast capacitor bank was measured as a function of pressure in the gap and voltage across the gap. Operation at a pressure of 0.5 μ Hg is reliable, independent of pressure, and results in a closing time jitter of 0.05 μsec. (auth)

21030 JPL-TR-32-17

California Inst. of Tech., Pasadena. Jet Propulsion Lab.

THREE-DIMENSIONAL BOUNDARY LAYER EQUATIONS OF AN IONIZED GAS IN THE PRESENCE OF A STRONG MAGNETIC FIELD. Ching-Sheng Wu. May 27, 1960. 26p. Contract NASw-6.

An attempt is made to formulate a new hydrodynamic boundary layer theory for an anisotropic ionized gas. A set of new boundary layer equations is obtained in general orthogonal coordinates. One of the new features indicates that the pressure gradient across the boundary layer can no longer be ignored. Since in the presence of a strong magnetic field the effective thermal conductivity is reduced, study of the heat transfer problem based on the new theory is of interest. (auth)

21031 LAMS-2444

Los Alamos Scientific Lab., N. Mex.

QUARTERLY STATUS REPORT OF THE LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM FOR PERIOD ENDING MAY 20, 1960. Samuel Glasstone, comp. and ed. July 1960. 58p. Contract W-7405-eng-36. OTS.

The major topics of study reported on include: (1) confinement of plasma in picket fence systems (cusped geometries); (2) trapping of plasma into magnetic confining systems by the entropy trapping method; (3) acceleration of plasma in various types of gun for use with the above, and studies of these guns; (4) axial compression in mirror geometry (Scylla and Orthogonal Pinch); (5) toroidal stabilized pinch (Perhapsatron S-5), loss process studies; (6) plasma rotation in crossed electric and magnetic fields in magnetic mirror geometry (Ixion); (7) plasma oscillations and observation of the modulation of a scattered microwave beam by plasma oscillations; (8) calculations of ionization and excitation cross sections; and (9) capacitor energy storage (Zeus) and component development. (auth)

21032 ML-669

Stanford Univ., Calif. Microwave Lab.

INVESTIGATION OF THE MICROWAVE PROPERTIES OF PLASMAS. Scientific Report No. 5 [Covering the Period] August 1 to October 31, 1959. M. Chodorow. Dec. 1959. 22p. Contract AF19(604)-5226. (AFCRC-TN-60-113; AD-233580).

The beam-interaction experiment was completed, and the results are discussed. A new tube for the production of thermal cesium plasma was constructed. Preliminary tests and measurements of this tube, as well as some of its operating characteristics, are presented. Projects on noise, harmonic generation, and microwave measurements in plasmas are summarized. Electron plasma waves, electron beam interaction with a plasma, parametric effects, electrostatic sound waves, and plasma confinement are discussed briefly. (W.D.M.)

21033 ORNL-2926

Oak Ridge National Lab., Tenn.

THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960. June 9, 1960. 122p. Contract W-7405-eng-26. OTS.

Separate abstracts were prepared for the major subdivisions of the thermonuclear research work. (For preceding period see ORNL-2693.). (W.D.M.)

21034 ORNL-2926(p.1-27)

Oak Ridge National Lab., Tenn.

DCX OPERATION AND PERFORMANCE. C. F. Barnett, J. L. Dunlap, R. S. Edwards, G. R. Haste, L. A. Kendig, J. A. Ray, R. G. Reinhardt, W. J. Schill, and E. R. Wells. p.1-27 of THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960.

The report for the previous period noted several observations that were then inconsistent or unexplained in measurements on the plasma trapped in the DCX: The determinations of axial-profile dimensions were inconsistent, a paddle obstructing a large portion of the

plasma had produced practically no decrease in the mean residence time of trapped protons, and the measured rate of trapped-particle loss by charge exchange in both the arc and the background gas was only about half the rate at which particles (H^+ ions) were being stored in the machine. The previous report expressed the belief that changes in the arc configuration could result in a significantly reduced cross section for charge exchange in the arc. It was also believed that deliberately introduced orbit precession ("deliberate precession") of the trapped ions would produce a further marked reduction in particle losses in the arc. Significant progress was made in several areas of investigation. Measurements of the plasma profile are more exact and reproducible. Further experiments made with obstructions in the plasma confirmed the observations given in the previous report; however, the extrapolation of the measured containment times to zero pressure does indicate that at lower pressures definite reductions in containment times would be produced by the obstruction. The technique for measuring the rate at which particles are lost by charge exchange was improved, and, within the accuracy of the experiment, nearly all of the incoming particles can be accounted for by this escape mechanism. Although the cause of spreading is still obscure, geometrical changes were made which greatly reduce the volume occupied by the trapped plasma. The properties of a number of arc configurations and a number of precession schemes were investigated, but the improvements hoped for as a consequence of arc changes and deliberate precession failed to materialize. The greatest single advance of the past period was probably the marked reduction in the plasma volume. Observations of this reduction have inspired optimism that containment was greatly enhanced and that the density of the plasma may with effort be further increased appreciably, perhaps even to the value theoretically required for burnout. (auth)

21035 ORNL-2926(p.28-59)
Oak Ridge National Lab., Tenn.
[DCX] VACUUM ARC RESEARCH. p.28-59 of THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960.

Optical measurements on the Luce vacuum carbon arc showed that, near the cathode of a long arc, ion temperatures of 750,000°K have to be postulated to account for the Doppler spreading of C^{++} lines. Excitation studies and radiometric microwave studies, on the other hand, show that the electron temperatures are about 40,000°K. Mass spectrometric studies show that the arc column is surrounded by an envelope containing C^+, C^{++}, and C^{+++}, the latter being closest to the axis. Measurements were made on the sensitivity of the pumping action and the ionic charge states to changes in the electrode configurations and the arrangement of the baffles through which the arc is made to pass. Photographs were made of curious spiral patterns of cathode spots for the vacuum carbon arc. The distribution, but not necessarily the number, of spots varied with current—going from a random to a spiral to an almost annular pattern with increasing current. No method of correlating these patterns with the distribution of filamentary patterns in the arc was found. Preliminary experiments showed that a vacuum deuterium arc can be operated successfully with little or no electrode erosion at 200 to 300 amp, and that the arc exhibits a pumping action (about 3400 liters/sec). (auth)

21036 ORNL-2926(p.60-3)
Oak Ridge National Lab., Tenn.
[DCX] ION SOURCE DEVELOPMENT. R. C. Davis, R. R. Hall, G. G. Kelley, N. H. Lazar, E. C. Moore, O. B. Morgan, and R. F. Stratton. p.60-3 of THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960.

A total ion current of 270 ma at 80 kv was extracted through a 0.052-in. aperture from a source which is a modification of the type called a duo-plasmotron by M. von Ardenne. At present there is no evidence that this source cannot be scaled up for higher currents. A model was built that should deliver the desired 500-ma beam with 80-kv acceleration, but it has been delayed in testing because of a relocation of equipment. A new source was built that is much simpler in design and easier to cool for high-current production. New equipment was designed and is being built that should allow analysis of 80-kv ion beams at 100 to 500 ma. (auth)

21037 ORNL-2926(p.64-8)
Oak Ridge National Lab., Tenn.
[DCX] THEORY. M. Rankin, G. R. North, and T. K. Fowler. p.64-8 of THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960.

A new Oracle code, BOP, was written for midplane ion orbits in the DCX trapped ion ring. The code uses a table of stored values of A/B_0 and B_2/B_0 obtained from the magnetic-field code No. 668 for DCX-1. Molecular-beam trajectories obtained agreed with those obtained by graphical methods. The periodicity of the orbits of 300-kev particles injected into the DCX at a radial distance of 5.3 in. and at a Z distance from the midplane of from 1 to 5 in. was plotted for what would correspond to an orbit time of 3 μsec. Little initial mixing or radial spread was indicated. A new code, CENSUS, was written for sorting Oracle data on particle distribution in the DCX trapped ion ring. One test of the code for an assumed path length of 200 ft (8 μsec for a 300-kev proton) was used as a basis for a three-dimensional model of the distribution. The mean energies E_+ and E_- of ions and electrons in the DCX at steady state after burnout were calculated on a simple model which takes into account effects of the plasma potential. Oracle code No. 668 was used for the computation of B_z, B_r, A, and rA for many coil arrangements. The code was modified to calculate axial fields more efficiently. A Long Solenoid Code was written which takes the field values for a single coil calculated by code No. 668, stores them on magnetic tape, and then selects and adds together the numbers necessary to give the field at a point due to n similar coils separated by an arbitrary distance. The Chandrasekhar function for dE_i/dt was evaluated for the range E_i = 50 to 300 kev in steps of 50 kev and E_e = 2 ev to 20 kev in logarithmic steps for both hydrogen and deuterium. (auth)

21038 ORNL-2926(p.70-9)
Oak Ridge National Lab., Tenn.
INSTRUMENTATION [FOR DCX]. p.70-9 of THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960.

Development of diagnostic equipment for neutral-particle detection is described, including oxide sandwich detectors, new transistorized low-current d-c amplifiers, and a telescope for particle detection and energy analysis. Certain transistors were found which have the interesting property of retaining high current amplification at very low currents. (auth)

21039 ORNL-2926(p.80-91)
Oak Ridge National Lab., Tenn.
MAGNETICS, HEAT TRANSFER, MECHANICAL FORCES,

AND ION TRAJECTORIES. W. F. Gauster and R. L. Brown. p.80-91 of THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960.

Devices for Drawing Ion Trajectories: An ion trajectory compass is described that can be used to trace ion trajectories in any magnetic field in which all flux lines are perpendicular to one plane. It is based on a nomogram for values from 0.8 to 76 kilogauss. A simpler device, an ion trajectory ruler, whose use requires additional calculations, is also described. Fitting of Magnetic Fields over Specified Volumes: Detailed examples of calculations are presented for the design of magnetic coils required to produce fields of a specified shape in a specified volume. Among the parameters considered are flux density, vector potential A_d, the scalar magnetic potential, current density, configuration of the system, and the movement of charged particles in the field. Essential to the approach is a "deviation coefficient," which is minimized to find the values of the desired parameters. (auth)

21040 ORNL-2926(p.92-3)
Oak Ridge National Lab., Tenn.
SPECTROSCOPIC INSTRUMENTATION. G. K. Werner. p.92-3 of THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960.

The resonance lines of carbon were of continuing interest in the study of carbon arcs, because changes in their intensities give a rough correlation of changes in the relative concentrations of the ion species. The resonance wavelengths occur in the vacuum region at λ 977, 1335, and 1548 A for C^{2+}, C^{+}, and C^{3+}, respectively. A "spectromonitor" was designed for continuous and simultaneous monitoring of these three carbon lines throughout any experiment. It consists of a 40-cm-radius concave grating in a vacuum-enclosed Paschen-Runge mounting, using fixed exit slits followed by associated fluorescent screens and a multiplier phototube. A fourth exit slit and phototube are included to measure the central image reflection. This latter gives a measurement of "total" radiation since it is a white-light reflection; however, the response is limited in the short-wavelength region by the low reflectivity of the grating and in the long-wavelength region by the phototube response. (auth)

21041 ORNL-2926(p.94-6)
Oak Ridge National Lab., Tenn.
CROSS-SECTION MEASUREMENTS [FOR H_2^+ AND D_2^+ DISSOCIATION]. D. P. Hamblen, L. A. Massengill, and H. Postma. p.94-6 of THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960.

The development of crossed-beam equipment proceeded toward the establishment of beams of sufficient uniformity for cross-section measurements, but no results from this apparatus are reported as yet. Preliminary results are presented on the dissociation cross section of molecular hydrogen ions by hydrogen and other gases in the energy range 200 to 600 kev. (auth)

21042 ORNL-2926(p.97-9)
Oak Ridge National Lab., Tenn.
OSCILLATIONS IN HOT-CATHODE GAS DISCHARGES. O. C. Yonts and J. P. Wood. p.97-9 of THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960.

The hot-cathode ion source of the Beta calutron, used in studies of high-current d-c discharges in hydrogen, develops undesirable r-f oscillations over many frequencies. A preliminary study indicated that the low-frequency oscillations appear to be almost entirely due to cyclotron oscillations either about the filament (when no magnetic field, other than that due to filament current, was applied) or about the filament and in the applied magnetic field when it is present. The high-frequency range presents a more complicated—and as yet unexplained—picture. (auth)

21043 ORNL-2926(p.100-8)
Oak Ridge National Lab., Tenn.
[DCX] VACUUM SYSTEMS AND TECHNIQUES. R. E. Clausing, J. W. Tackett, and C. E. Normand. p.100-8 of THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960.

The need for high-speed high-vacuum pumps may be partially satisfied by the development of getter pumps utilizing the adsorption of gases on evaporated metal films. Such pumps can be simply made and are adaptable to use inside experimental apparatus in such a way as to provide large pumping areas and, it is hoped, large speeds. A large number of evaporating methods were investigated, and some of the satisfactory ones are reported. The study of evaporation sources is preparatory to a more detailed study of the principles and application of getter pumping. Fusible seal materials for use in thermonuclear experimental apparatus were studied. The most promising alloys and the materials with which they may be used are given. Routine vacuum pumping tests were run on several pumps and results are discussed. (auth)

21044 ORNL-2926(p.109-11)
Oak Ridge National Lab., Tenn.
SPUTTERING. O. C. Yonts, R. T. Nowak, A. W. Tell, J. P. Wood, and H. L. Huff. p.109-11 of THERMONUCLEAR PROJECT SEMIANNUAL REPORT FOR PERIOD ENDING JANUARY 31, 1960.

A small 180° Dempster-type mass spectrometer was designed and constructed for measurements of the partial pressures of various gases in an analysis of the pressure dependence of sputtering. It is designed to be mounted on the receiver of the Beta calutron. Currents of 100 μμamp were easily obtainable on N_2^+ or Ar^+ at 10^{-5} mm Hg. Improvements in the gas efficiency of the calutron ion source are described. (auth)

21045 TID-6158
New York Univ., New York.
THE USE OF ATOMIC BEAMS AS A PROBE FOR STUDYING LOW DENSITY PLASMAS. Quarterly Report for March 1, 1960 to July 1, 1960. Leon H. Fisher. 5p. Contract AT(30-1)-2397. OTS.

The use of a monoenergetic atomic (alkali) beam as a probe for studying plasmas of density between 0.1 and 100μ is considered. A method was derived for studying the attenuation of a neutral beam by a fully ionized, single constituent plasma of fixed density and variable temperature, neglecting electron-beam scattering. (C.J.G.)

21046 USASRDL-TR-2060
Army Signal Research and Development Lab., Fort Monmouth, N. J.
MICROWAVE MEASUREMENTS IN PLASMAS. Rudolf Buser and Paul Wolfert. Sept. 15, 1959. 34p.

A discussion is contained of both the theoretical and the experimental aspects of microwave measurements in plasmas. The discussion includes a theoretical consideration of the properties of plasmas with respect to electromagnetic wave propagation, both with and without the presence of a magnetic field. Experimental results are also included, giving measurements of the transmitted and reflected amplitudes, phase measurement of the transmitted wave, and phase measurement of the reflected wave. (auth)

21047 CEA-tr-A-447
CONFIGURATIONS DE PLASMA AVEC COURANTS DE SURFACE MAINTENUS EN ÉQUILIBRE PAR UN CHAMP MAGNÉTIQUE. (Configurations of Plasma with Surface Current Maintained by a Magnetic Field). R. Kippenhahn. Translated into French from Z. Naturforsch. 13a, 260-7 (1958). 22p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 11548.

21048 CEA-tr-A-558
LA THÉORIE DES PROCESSUS THERMONUCLÉAIRES QUASI-STATIONNAIRES. (The Theory of Quasi-stationary Thermonuclear Processes). L. Biermann and A. Schlüter. Translated into French from Z. Naturforsch. 12a, 805-14 (1957). 32p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 4277.

21049 CEA-tr-A-699
SOMME D'ÉTAT ET TENSION EFFECTIVE D'IONISATION A L'INTÉRIEUR DU PLASMA. (Partition Function and Effective Ionization Potential in the Interior of Plasma). G. Ecker and W. Weizel. Translated into French from Z. Naturforsch. 12a, 859-60(1957). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 4286.

21050 JPRS-2719
AN APPROXIMATE SOLUTION OF THE PROBLEM OF THE MOTION OF A CONDUCTIVE PLASMA. G. A. Skuridin and K. P. Stanyukovich. Translated from Doklady Akad. Nauk S.S.S.R. 130, 1248-51(1960). 8p. OTS.

A method of solution is presented for the following case of a linear hyperbolic partial differential equation: $u(x, y, z, t) = A(x, y, z) \exp\{i\omega[t-\phi(x, y, z)]\}$. (W.L.H.)

21051
THE PROSPECTS OF MHD POWER GENERATION. Leo Steg and George W. Sutton (General Electric Space Sciences Lab., Philadelphia). Astronautics 5, No. 8, 22-5; 82-6 (1960) Aug.

The prospects for magnetohydrodynamic (MHD) power generation range from a small, short-duty-cycle unit for space applications to a large power station for commercial use. The gaseous MHD generator appears at first glance to have some outstanding advantages over the conventional turbogenerators in both stationary and auxiliary power applications. Appropriately high gas conductivity and reliable flow-containment at temperatures above 2500°K appear as the central initial problems of MHD power generation. Materials that can operate at 2500°K in reactive atmospheres for extended periods of time must be developed. The MHD generator, when feasible, will have to be measured against more conventional improvements of steam cycles. Ignorance of reliability and comparative cost makes a complete evaluation premature. Major application, other than the short-duty-cycle generator for space vehicles, must await answers to these problems. (M.C.G.)

21052
THE MAGNETOGRAVITATIONAL INSTABILITY OF AN INFINITE COMPRESSIBLE CYLINDER. THE FORMULATION OF THE LOCAL INSTABILITY CONDITION. Andrzej G. Pacholczyk (Univ. of Warsaw and Univ. of Turin). Atti accad. sci. Torino. Classe sci. fis., mat. e nat. 94: 521-32(1959-1960). (In English)

The problem of the magnetogravitational instability of an ideal compressible cylinder in the presence of a magnetic field parallel to the axis of symmetry of the system is considered. From the basic equations of the problem considered, the solution of the equations of equilibrium of the external and internal part of the system is obtained by the method of series development. The local instability conditions of the cylinder are formulated for the case of a uniform magnetic field with intensity proportional to the density of the medium. (tr-auth)

21053
SOME MAGNETODYNAMIC STATIONARY MOTIONS WITH AXIAL SYMMETRY OF AN ELECTRICALLY CONDUCTING COMPRESSIBLE FLUID MASS EXPOSED TO ITS OWN GRAVITATION. Tino Zeuli. Atti accad. sci. Torino. Classe sci. fis., mat. e nat. 94: 533-51(1959-1960). (In Italian)

The axial symmetrical motion of a gaseous mass of such high electrical conductivity that it can be considered infinitely conductive and exposed to its own gravitational field is considered. The mass is under adiabatic conditions in which it generates a magnetic field. (tr-auth)

21054
PERTURBATION METHOD FOR THE PROPAGATION OF ELECTROMAGNETIC WAVES IN A PLASMA PARTIALLY SUPPLYING A CIRCULAR WAVE GUIDE. Lorenzo Cairó Compt. rend. 250, 4129-31(1960) June 20. (In French)

A circular guide, in which the plasma is arranged in the interior in a concentric tube, is considered. A relationship is found which connects the value of the propagation constant to the diameter of the two concentric tubes. One is limited to the basic mode of the vacuum guide. (tr-auth)

21055
EFFECT OF RECTIFICATION IN GASEOUS DISCHARGES WITH CROSSED ELECTRIC AND MAGNETIC FIELDS. Gilbert Boucher and Oskar Doehler. Compt. rend. 251, 59-61(1960) July 4. (In French)

The effect of a transverse magnetic field on the initiating conditions for a gaseous discharge was examined and it was found that there exists a polarity effect at pressures of the order of 1 to 10^{-5} Torr. It is shown here that this effect, applied to the rectification of low-frequency currents, can be made more efficient if the magnetic field is localized in the vicinity of one of the electrodes of the rectifier. (J.S.R.)

21056
EXPERIMENTAL 100,000 JOULE CAPACITOR BANK FOR PLASMA RESEARCH. R. Buser and P. Wolfert (U. S. Army Signal Research and Development Lab., Fort Monmouth, N. J.). Electronics 33, No. 32, 58-61(1960) Aug. 5.

An experimental 100,000 joule capacitor bank was constructed for plasma research. The capacitor bank consisted of five sets of eight high-voltage, low-inductance capacitors connected in parallel. Two arrangements were possible: a circularly symmetric arrangement using coaxial cable connections and a linearly symmetric arrangement using transmission-line connections. Both capacitor bank arrangements were built and used. A combined system offered the most compact arrangement. Airgap switches were selected for geometrical reasons. Two timing problems were solved: first, firing the bank with an adjustable time delay against a zero pulse, and second, an adjustable delay between the firings of the bank sections to vary the shape of the discharge current. (M.C.G.)

21057
HEATING OF A PLASMA BY ACOUSTIC WAVES. Tarô

Dodo (Hitachi Central Research Lab., Tokyo). J. Phys. Soc. Japan 15, 1292-5(1960) July. (In English)

Generation of an acoustic wave and transformation of its energy into thermal energy are considered. An acoustic wave is generated, imposing an oscillating magnetic field to a cylindrical plasma in a static magnetic field. When a suitable frequency of the oscillating field is chosen, an acoustic wave is excited at an intermediate state between adiabatic and isothermal states. In this situation acoustic energies are transformed into thermal energies through the irreversible flow of heat due to stress relaxation. In this method, efficiency of heating is very high. Calculation shows that this method should be suitable to heat a plasma of moderate temperature ($10^5 \sim 10^6$ °K) and of high density ($10^{14} \sim 10^{16}$ particles/cm^3). (auth)

21058

PERIODIC MAGNETIC FIELD FLUCTUATIONS IN THE SCEPTRE DISCHARGE. N. L. Allen (Associated Electrical Industries, Aldermaston, Berks, Eng.). Nature 187, 279-82(1960) July 23.

The SCEPTRE discharges appear to be stable against gross wriggling, but measurements with magnetic probes have invariably shown fluctuations of 10 to 20% of the average magnetic fields in the discharge with mean frequencies of 10^4 to 10^5 cps. The fluctuations in the axial magnetic field component suggest the existence of a helical type instability near the discharge channel surface. The instability is moving either in the axial direction at 1.5×10^6 cm/sec or in the azimuthal direction at a rotational frequency of 2×10^4 cps, or could be a combination of both types of motion. (B.O.G.)

21059

MICROWAVE CONDUCTIVITY OF A PLASMA IN A MAGNETIC FIELD. Donald C. Kelly (Yale Univ., New Haven). Phys. Rev. 119, 27-39(1960) July 1.

The Boltzmann equation for electrons in a uniform isothermal plasma is solved by expressing the distribution function as a series of orthogonal polynomials in velocity space with time dependent expansion coefficients. The microwave conductivity is simply related to certain coefficients. Particular attention is devoted to the case in which the plasma is subject to a constant magnetic field and a microwave electric field. By introducing an "effective" electron temperature, convergence is attained for strong as well as weak electric fields. The formulation is particularly suited for problems involving partially ionized gases which contain several species of ions and neutrals. The conductivity of a completely ionized gas is calculated with and without consideration of electron-electron collisions, and the ratio (γ_E) of the two results is graphically illustrated as a function of microwave frequency. (auth)

21060

EXCITATIONS IN A HIGH DENSITY ELECTRON GAS. [PART] I. Tunemaru Usui (Univ of Chicago and Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 787-98(1960) May. (In English)

A new systematical method for the description of an electron gas in terms of bosons is developed. This boson corresponds to an "exciton," i.e., a pair of an electron outside the Fermi sphere and a hole inside. The formalism is particularly suitable to the system at high density, as suggested by Sawada's discussion of the same system. As a straightforward application, the effect of electron exchange on the plasma frequency is calculated. The result coincides with that of a Hartree-Fock treatment. (auth)

21061

EXCITATIONS IN A HIGH DENSITY ELECTRON GAS. II. DIAMAGNETISM. Emiko Fujita and Tunemaru Usui (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 799-809 (1960) May. (In English)

As an application of the method of describing a high density fermion gas in terms of electron-hole pairs, diamagnetism of the gas is investigated. The two corrections to Landau diamagnetism obtained came from the screened interaction of exchange type. (auth)

21062

GAS DISCHARGE APPARATUS. Peter Clive Thonemann (to United Kingdom Atomic Energy Authority). British Patent 839,247. June 29, 1960.

A pinch device is described for heating gases to nuclear interaction temperatures. It consists of a toroidal vessel, a primary winding with conductors around and parallel to the torus circular axis, and a means for exciting the winding to induce a ring discharge in the torus gas, preferably an r-f source. Temperatures of the order of 10^7 °K can be obtained without excessive power dissipation at the tube wall. External stray r-f magnetic fields are eliminated by a toroidal Cu shield with insulating joints enclosing the gas space. When the discharge current reaches several hundred amp, the discharge is restricted and the pressure can be further reduced, e.g., to 10^{-5} mm Hg, thus reducing ion pair generation and wall power dissipation; therefore, the ions tend to come into temperature equilibrium with the electrons. (D.L.C.)

21063

GAS DISCHARGE APPARATUS. Peter Clive Thonemann, William Thomas Cowhig, and Philip Alan Davenport (to United Kingdom Atomic Energy Authority). British Patent 839,248. June 29, 1960.

A pinch device is described for heating gases to nuclear interaction temperatures around 10^7 °K. It consists of a toroidal vessel, a plurality of toroidal windings spaced around it, and a multiphase a-c supply connected to the windings for the pinch effect. The current path may be stabilized by d-c conductors along the path, and external stray magnetic fields are eliminated by magnetic screening. A design for the containment of the apparatus within a biological shield is given. (D.L.C.)

21064

HIGH ENERGY GASEOUS DISCHARGE DEVICES. (to U. S. Atomic Energy Commission). British Patent 840,017. July 6, 1960.

An apparatus is described for producing high-energy gas ionization discharges. The apparatus consists of a high-energy electrical discharge tube as the envelope, a pair of main discharge electrodes supported in opposition to the envelope, and a metallic shell consists of spaced helical turns connected at its ends to one of the electrodes and a second element of space helical turns supported in a superposition outside the first element with a gap between the turns of the first element. (W.L.H.)

21065

IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Jiri George Linhart (to British Thomson-Houston Co., Ltd.). British Patent 841,253. July 13, 1960.

A thermonuclear reactor for use with light elements, e.g., H and D, is described. In order to obtain electron temperatures of $>10^7$ °K necessary for achieving ion temperatures of $>10^6$ °K for thermonuclear reactions, the gas is subjected simultaneously to a magnetic field and an a-c electric field perpendicular to the magnetic field and oscillating at the cyclotron resonant frequency. The gas is a mixture of the light element and some other substance (e.g., Li) added to increase collision cross sections. Water

or some other liquid may serve the dual purpose of coolant and moderator. A modified reactor for continuous process is also shown. (D.L.C.)

Shielding

21066
STATE OF DEVELOPMENT IN THE RANGE OF REACTOR SHIELDING. I. THEORY AND PRACTICE. Ir. H. van Annmers. Atomenergie 2, 107-15(1960) July. (In Dutch)

In the design and calculation for the shielding of a nuclear reactor, one encounters problems of a practical and theoretical nature. As in most practical cases one has to deal with shielding against both gamma rays and neutrons; this subject is discussed in detail first. It is followed by a survey of results attained in recent years. The article ends with a description of radiation detection instruments for shielding research. (auth)

21067
SLIDE RULE OF SHIELDING AGAINST GAMMA RADIATION. J. M. Lavie (Centre d'Études Nucléaires, Saclay, France). Bull. inform. sci. et tech. (Paris) No. 39, 43-8 (1960) Apr. (In French)

A simple slide rule permitting the rapid solution with a good approximation of all the practical problems connected with the prevention and protection against external gamma irradiation is presented. The slide rule was designed for a point source, but its range of utilization can be extended to a surface source with a good approximation. (J.S.R.)

21068
SHIELDING OF NEUTRONS AND GAMMA RADIATION ORIGINATING IN THE SHIELD. T. Springer and M. Oberhofer (Technische Hochschule, Munich). Kerntechnik 2, 203-5(1960) June. (In German)

For neutron shielding in nuclear engineering operations with Ra-Be or Po-Be neutron sources, neutron generators, or reactors, hydrogen-rich materials (water, paraffin, plastics, oil, tar, etc.), heavy materials (lead, iron, bismuth, concrete, etc.), or in many cases combinations of these are used according to the special requirements. The interaction of slow and fast neutrons with these materials is discussed, and formulas are given with which neutron shielding can be estimated without much mathematical effort. (tr-auth)

21069
IMPROVEMENTS IN OR RELATING TO SHIELDING FOR NUCLEAR REACTORS. Everett Long and Jack Jones (to United Kingdom Atomic Energy Authority). British Patent 836,147. June 1, 1960.

The design and materials for the neutron shield of a reactor are reported. The neutron shield is placed adjacent to the core of the reactor. The shield has holes passing through it to provide access to the core. Tubes are arranged in the holes and end in neutron shield plugs. The materials used in the construction of the shielding and tubes have a high neutron absorption cross section. (W.L.H.)

Theoretical Physics

21070
A REPRESENTATION OF THE ELECTROMAGNETIC RADIATION FIELD. Achille Papapetrou. Compt. rend. 250, 4292-4(1960) June 27. (In French)

The Maxwell equations united to the Lorentz condition representing an electromagnetic radiation field are analyzed, and it is shown that the general electromagnetic radiation field depends essentially on two independent wave functions. (J.S.R.)

21071
COLLECTIVE MOVEMENT IN THE PHOTONUCLEAR GIANT RESONANCE. M. Fabre de la Ripelle (Faculté des Sciences, Orsay, France). J. phys. radium 21, 302-4 (1960) May. (In French)

A quantum mechanical justification of the Goldhaber and Teller collective model is given for the photonuclear giant resonance using the Gammel-Thaler potential and experimental nuclear form factors. One finds thus: the energy of the giant resonance, the energy of splitting for deformed nuclei, and the cross section for excitation of collective motion by protons within the Born approximation. (auth)

21072
ENERGY GAP IN NUCLEAR MATTER. V. J. Emery and A. M. Sessler (Univ. of California, Berkeley). Phys. Rev. 119, 248-50(1960) July 1.

The magnitude of the energy gap in nuclear matter associated with a highly correlated ground state of the type believed to be important in the theory of superconductivity was evaluated theoretically. The integral equation of Cooper, Mills, and Sessler is linearized and transformed into a form suitable for numerical solution. The energy gap, calculated by using an appropriate single-particle potential and the Gammel-Thaler two-body potential, is found to be a very strong function of the density of nuclear matter, and of the effective mass at the Fermi surface. It is concluded that the magnitude of the energy gap for nuclear matter should not be compared directly with experimental values for finite nuclei, although the results suggest that if the theory is extended to apply to finite nuclei it probably would be in agreement with experiment. (auth)

21073
HIGH-ENERGY LIMIT OF FORM FACTORS. S. D. Drell and F. Zachariasen (Stanford Univ., Calif.). Phys. Rev. 119, 463-6(1960) July 1.

This theorem is proved: For finite charge renormalization constant Z_3^{-1}; the form factors describing any vertex with two particles on the mass shell must vanish at infinite momentum transfer. The relation of this result to the work of Lehmann, Symanzik, and Zimmermann is discussed. (auth)

21074
A SOLUTION OF THE COMBINED GRAVITATIONAL AND MESIC FIELD EQUATIONS IN GENERAL RELATIVITY. Ratan Lal Brahmachary (Indian Statistical Inst., Calcutta). Progr. Theoret. Phys. (Kyoto) 23, 749-50(1960) Apr. (In English)

Solutions of the combined gravitational and mesic fields are attempted. Since the mesic field cannot be solved in strictly empty space, it is solved for nonempty space. (D.L.C.)

REACTOR TECHNOLOGY

General and Miscellaneous

21075 AERE-RS/L-30
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
HARWELL REACTOR SCHOOL. HOW TO USE THE REACTOR SIMULATOR. R. G. Davies. June 1957. 23p.

The reactor school simulator is an analogue computer in a console resembling the control desk of a nuclear reactor. This manual is intended to assist the operator in understanding how the simulator works and how to use the instrument to increase his understanding of reactor kinetics. (auth)

21076 ANL-6022

Argonne National Lab., Ill.

TESTS OF DEFECTED THORIA-URANIA FUEL SPECIMENS IN EBWR. R. F. S. Robertson. May 1960. 88p. Contract W-31-109-eng-38. OTS.

A potential thermal reactor fuel is provided by ThO_2 enriched with $U^{235}O_2$. The two tests were carried out in EBWR to establish the rates of release of fission products, especially gases, from such a fuel and to assess the magnitude of the resulting operational problems. The fuel used in both tests was 90 wt.% ThO_2, 10 wt.% $U^{235}O_2$ in the form of pellets. In Test No. 1 the average diameter of the pellets was 0.300 in., and five pellets made a total fuel length of 3.1 in. The average density was 9.5 g/cc. The pellets were sheathed in a stainless steel tube welded shut at both ends; a 0.010-in. diameter hole was drilled through the sheath at the center of the fuel rod. In Test No. 2 a much larger fuel assembly was used; 82 pellets of 0.312-in. diameter made a total fuel length of 48 in., i.e., the same length as the fuel in an EBWR fuel plate. Average density was 9.0 g/cc. Again both ends were welded shut and the sheath was defected with a 0.20-in. diameter hole located at the top of the top pellet of the assembly. The fuel specimen was mounted in a coolant channel of a natural uranium fuel element and was irradiated in EBWR. In each test the maximum thermal neutron flux in the fuel (using $\sigma_f = 545$ barns) was about 8×10^{12} n/(cm^2)(sec). Surface heat rates were about 160,000 Btu/(hr)(ft^2)(max) in both tests. Test 1 continued for a period corresponding to about 1.2% burnup of the U^{235} atoms while the second test had a burnup of about 3.2% (max) of the U^{235} atoms. During each test, activities of various nuclides in the reactor water were measured, but most emphasis was placed on measurement of the rate of evolution of fission product gases. This was done by taking samples of air ejector gases and analyzing, by chemical means and by use of a 200-channel γ-ray spectrum analyzer, for the four nuclides Xe^{138}, Kr^{88}, Xe^{135}, and Xe^{133}. From the measured activity in the sample, knowing the flow rate of the air ejector gases, the evolution rates of these nuclides were calculated. Evolution rates were also measured as a function of reactor power. During both tests no increase in the gross activity of the reactor water could be observed. This is not surprising in view of the fact that during normal operation the major activities in the water were due to the activation of corrosion products and structural materials rather than to the presence of fission products. Radiation-monitoring instruments in the steam lines or in the air ejector gases did not show any significant increase in counting rate during either test. There was, however, an extremely high background due to N^{16}, which completely overshadowed any activity due to fission product gases. Analyses of the air ejector gases showed that evolution rates of fission product gases increased over those observed when no defect was present. It was found that if the control rod nearest to the defected specimen was moved so as to increase the neutron flux in the specimen, a burst of activity was emitted; this was indicated by a peak in the counting rate of the γ-ray monitor at the air ejectors. This phenomenon was not observable when any other control rod was moved. It was also found that for fission product gases, the quotient R/Y was directly proportional to $1/\sqrt{\lambda}$, where R was the rate at which gas was escaping from the defect (atoms/sec), Y was the fission yield, and λ (sec^{-1}) was the decay constant of the gas. It can be shown that this relationship is consistent with release of gases by a diffusion-controlled mechanism through the oxide. (auth)

21077 BAW-1191

Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.

THORIUM URANIUM PHYSICS EXPERIMENTS FINAL REPORT. N. L. Snidow, R. C. Anderson, M. L. Batch, G. A. G. deCoulon, R. H. Lewis, and W. M. Vannoy. May 1960. 213p. Contract AT(11-1)-766. OTS.

The Thorium Uranium Physics Experiment (TUPE) is a study of uniform lattice cores moderated with light water. TUPE cores contain thorium oxide-uranium oxide pins clad with Al and have metal-to-water volume ratios, M/W, ranging from 0.3 to 1.0. The basic aim of the project was to measure lattice parameters of cores with ratios ranging from 0.3 to 1.0, and to compare the results with different theoretical models. Results of the measurements on various cores are discussed in detail. (See also BAW-1193.) (W.D.M.)

21078 HW-63576(p.36-54)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE FUEL TEMPERATURE COEFFICIENT FOR 7-ROD CLUSTERS OF URANIUM OXIDE WITH AIR COOLANT. F. C. Engesser and T. J. Oakes. p.36-54 of NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959.

The reactivity held in the fuel temperature coefficient of a 7-rod UO_2 cluster was measured between about 50 and 500°C. The measurements were obtained by heating the fuel in the central section of a three piece cell. This three piece unit was at the central position of a 3×3 array of nine such cells stacked with a surrounding "buffer zone" layer of graphite hole-bars inside the cubical test cavity of the Physical Constants Testing Reactor (PCTR). The buffer zone layer contained sufficient one-half inch diameter natural uranium fuel rods to properly adjust the fast and slow fluxes incident on the UO_2 clusters to those which would be found in an infinite lattice. Measurements of the change in reactivity of the PCTR were made as a function of the fuel temperature of the test section of the central cell. (auth)

21079 NAA-SR-4869

Atomic International. Div. of North American Aviation, Inc., Canoga Park, Calif.

VALVE STEM FREEZE SEAL FOR HIGH-TEMPERATURE SODIUM. J. S. McDonald. July 30, 1960. 37p. Contract AT-11-1-GEN-8. OTS.

Valve stem freeze seals for high-temperature service in advanced sodium-cooled reactor systems were studied. An experimental model, suitable for use with a 6-in. size valve, operated satisfactorily under a variety of conditions. The freeze seal region was cooled by natural convection to ambient atmosphere; cooling by both circumferential and longitudinal finned sections was experimentally studied. The operating conditions included sodium bulk temperatures up to 1300°F, sodium pressures up to 75 psig, and ambient temperatures as high as 150°F. Anticonvection rings were positioned in the sodium-filled annulus between stem and stemguide, and the effects of their presence was studied. Predictions of temperature profiles along the stem, using several different analytical methods, were compared with experimental results. (auth)

21080 NAA-SR-5392

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THE DETERMINATION OF LATTICE PARAMETERS BY

MEANS OF MEASUREMENTS ON A SINGLE FUEL ELEMENT. J. W. Zink and G. W. Rodeback. July 15, 1960. 33p. Contract AT-11-1-GEN-8. OTS.

The four-factor critical equation for a heterogeneous thermal reactor is examined in detail. It is then expressed in terms of parameters which characterize separately the fuel element, the moderator, and the lattice-cell geometry of a heterogeneous thermal reactor. Methods for determining the parameters are discussed. The results of measurements and analysis for two different fuel element types are compared with the results of measurements made on full lattices consisting of these fuel elements. (auth)

21081 RPI-35(AECL)

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

EXPERIMENTS ON D_2O-MODERATED LATTICES OF NATURAL URANIUM HOLLOW TUBES. D. F. Allen, D. W. Hone, J. C. Mills, P. W. Mummery, R. M. Pearce, and L. Pease. Oct. 1959. 23p.

Results of experiments in ZEEP to determine the nuclear characteristics of a proposed UK reactor designated as HIPPO are presented. These results include Laplacians as a function of rod spacing, the thermal neutron distribution within a cell, and the uniform temperature coefficient of reactivity. (J.R.D.)

21082 CEA-tr-A-405

CALCUL DU FACTEUR DE MULTIPLICATION INFINI UN RÉSEAU DOUBLE. (Calculation of the Infinite Multiplication Factor for a Double Lattice). H. Engel. Translated into French from Atomkernenergie 2, 168-76(1957). 27p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 12904.

21083 CEA-tr-A-697

CONTRIBUTION À LA THÉORIE DES RÉACTEURS SEMI-INTERMÉDIAIRES ET SEMI-THERMIQUES AVEC ENRICHISSEMENT EN Pu. (Contribution to the Theory of Semi-Intermediate and Semi-Thermal Reactors with Pu Enrichment). H. J. Bruchner and H. Kornbichler. Translated into French from J. Nuclear Energy 5, 363-72(1957). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 1695.

21084

MECHANICAL PROBLEMS OF HOMOGENEOUS REACTORS WITH CIRCULATING FUEL. B. L. A. van der Schee. Atoomenergie 2, 85-99(1960) June. (In Dutch)

Because in homogeneous reactors with circulating fuel the radioactivity is spread over the entire installation, very high requirements are made on the leak tightness and reliability of the apparatus. Many technical details must still be solved before one can speak of a working reactor installation. The problems which arise in the design of pumps, valves, heat exchangers, and measurement and control apparatus are discussed. In connection with the safety of the environs, the enclosure of the complete installation, especially for homogeneous reactors, forms an important technical question. Two methods of maintenance and repair are discussed. (tr-auth)

21085

SOME CIVIL ENGINEERING AND ARCHITECTURAL ASPECTS IN THE CONSTRUCTION OF BUILDINGS FOR NUCLEAR REACTORS. Ignacio Frisancho Pineda. Bol. inform. junta control energía atómica (Peru) 5, 53-80(1960) Mar.-Apr. (In Spanish)

Civil engineering and architectural aspects in the construction of buildings for pressurized water reactors, boiling water reactors, and gas-cooled reactors are reviewed. The selection of the site for the reactor is discussed. The plan of construction is outlined. The fundamental civil engineering problems discussed include selection of construction materials, cements, concrete, and resistance to seismic and explosive vibrations. (J.S.R.)

21086

STUDY OF SITES INTENDED TO RECEIVE ATOMIC INSTALLATIONS AND THEIR PROTECTION AGAINST RADIATION. A. Menoux (Centre d'Études Nucléaires, Saclay, France). Bull. inform. sci. et tech. (Paris) No. 39, 11-13(1960) Apr. (In French)

In radiation protection, one of the most important problems to be considered is that of the contamination of the site of the nuclear installation. Three principal aspects of this problem are considered, the site study, ecological surveillance, and the study of results of major accidents. The site study, made before the final selection and construction of the installation, has the object of limiting the consequences of an eventual contamination. The ecological surveillance has the object of detecting and controlling the different possibilities for the contamination of the site by the normal operation of the installation. The study of the risks in case of an important accident at the site must be prepared to determine the procedure. Each of these problems is considered. (J.S.R.)

21087

THE USE OF ORGANIC FLUIDS IN NUCLEAR REACTORS. S. Battaglia (Montecatini S.p.A., Milan) and U. Cassinari (AGIP Nucleare, Milan). Energia nucleare (Milan) 7, 457-62(1960) July. (In Italian)

A review is given of the organic fluids which may be considered as heat transfer media for nuclear reactors. The effect of temperature and of the composition of high boiling compounds on their physical properties are reviewed as well as the formation and means of removal of gas and polymers resulting from pyrolytic and radiolytic damage. (auth)

21088

NUCLEAR COMPOSITION OF NATURAL URANIUM FUEL UNDER LONG TERM IRRADIATION IN A THERMAL REACTOR. G. Casini and A. Prosdocimi (EURATOM, Mol, Belg.) and C. Passarini (AGIP Nucleare, Milan). Energia nucleare (Milan) 7, 488-94(1960) July. (In English)

The fuel composition in a natural uranium and graphite power reactor with regard to the isotopes of uranium and plutonium, and to the main fission products, is analyzed by means of the solution of the equation set representing their concentrations, the calculation being carried out by an electronic analogue computer. The dependence of the cross sections on the neutron spectrum and its changes through the reactor life are taken into account by the application of the Westcott effective cross sections. The calculation is repeated at several temperatures in order to analyze the dependence of the concentrations on the actual temperature existing in the different regions of a typical power reactor. (auth)

21089

SCHEME FOR BURNUP CALCULATIONS IN THERMAL REACTORS WITH A HARD SPECTRUM. III. TREATMENT OF DIFFERENT TRANSFORMATION SCHEMES BY THE METHOD OF CONTINUOUS FUEL THROUGHPUT. K. Meyer and E. Griepentrog (Wissenschaftlich-Technische

Büro für Reaktorbau, Berlin). Kernenergie 3, 1-13(1960) Jan. (In German)

Feinberg and his co-workers set up a model which incorporates the idea that the fuel is so contained in the reactor that in every sufficiently large cell parallel to the reactor axis the length of which equals the height, and whose volume is sufficiently small compared to the total volume of the reactor, a large part of the fuel elements have a stationary burnup distribution. Also, this distribution should be independent of the direction in a given solid cross section of the reactor. A series of transformation schemes is presented in which the fuel is moved in some manner during operation of the reactor in order to obtain favorable values for distribution of power density or burnup. (T.R.H.)

21090

CALCULATION OF THE TEMPERATURE GRADIENT AND THERMAL STRESS IN THE CONTAINER OF A PRESSURIZED WATER REACTOR. W. Mai (Wissenschaftlich-Technische Büro für Reaktorbau, Berlin). Kernenergie 3, 407-13(1960) May. (In German)

The stresses developed in a pressurized water reactor are caused primarily by the overpressure from the boiling water and by heating due to γ and neutron absorption. The basic equations were set up to derive linear elasticity theory formulas for thermal stresses in hollow cylinders for the case of a special thermal source distribution which varies radially and axially. In an example it is shown that for heterogeneous reactors without a thermal shield, and with a maximum thermal neutron flux of $5 \times 10^{13}/cm^2$ sec and ordinary core construction, the maximum thermal stress in the vessel wall produced by γ quanta absorption is of the same order of size of the stresses produced by the inner pressure. The effect of neutrons is slight, and therefore negligible. (T.R.H.)

21091

NEW DEVELOPMENT TENDENCIES IN THE RANGE OF REACTOR FUEL ELEMENTS. O. Werner (Bundesanstalt für Materialprüfung, Berlin-Dahlem). Kerntechnik 2, 192-200(1960) June. (In German)

The transition from research reactors to power reactors is characterized by the use of higher operating temperatures in the power reactors. More rigid requirements for the fuel material and the fuel elements therefore appear. The properties of metallic uranium as fuel material and the improvement of these properties by alloying are reported. This improvement consists of the shape and dimensional stability in thermal cycling, stability with respect to neutron radiation, and the corrosion stability of the uranium by alloying. In this connection the requirements for fuel material in homogeneous reactors with liquid or solid fuel are given. (tr-auth)

21092

GEAR DRIVE FOR ROTARY COVER OF NUCLEAR REACTORS. Kerntechnik 2, 213(1960) June. (In German)

For the loading and unloading of fuel elements, reactors are provided with a large rotary cover and an excentrically placed small rotary lid which has an assembly hole passing through a plug capable of being closed. By rotation of both covers it is therefore possible to bring the assembly hole of the small cover accurately over each one of the numerous fuel element positions so that the exchange of the fuel elements can be effected without difficulty. The large cover is driven with a permanently installed motor and the small one generally by hand. The invention removes some electrical and mechanical difficulties by application of a single drive which permits both covers to be operated with a single motor. A diagram of the gear drive is given.

21093

DECONTAMINATION OF GASES FROM NUCLEAR REACTORS. K. Hintermann. Neue Technik 1, No. 1, 5-12 (1959) May. (In German)

Some general aspects of the use of gas as a heat carrier in nuclear reactors are discussed first. Thereafter the separation of aerosols by filters is described. As a means for the extraction of radioactive gases from helium or neon a cold trap is calculated. The use of charcoal beds is discussed. (auth)

21094

REACTOR TYPES. O. Schaub and Th. Schaub (Reaktor A. G., Würenlingen, Switzerland). Neue Technik 1, No. 1, 20-9(1959) May. (In German)

Special characteristic features of the most important reactor components are described, these being the fundamental reason for the many types of reactors. Already existing, as well as reactors in the course of construction are referred to, and special constructional features of the different types discussed. (auth)

21095

COMPARISON OF POWER CYCLES FOR THE HIGH-TEMPERATURE GAS-COOLED REACTOR. W. Spillman (Escher Wyss Aktiengesellschaft, Zurich). Neue Technik 1, No. 2, 14-20(1959) June. (In German)

For gas-cooled reactors two thermodynamic cycles working according to different principles are used, namely the direct single loop and the two circuit system with indirect heat addition to the working medium. The direct closed cycle gas turbine circulates the cooling medium through the heat source without additional losses and without the need for external pumping power. For the two loop cycle various possibilities for the circuit exist. Some of these cycles with their losses are compared with the single loop giving results as follows: The pumping power needed for a primary cycle is found to be in the range of 8 to 20% of the useful output. With a turbine in the primary cycle driving the circulation-compressor losses of approximately 10% have to be expected, mainly due to the fact that the maximum temperature in the working cycle is lower than the reactor outlet corresponding to the turbine expansion. A number of other diagrams allowing the working cycle to operate close to reactor outlet temperature are discussed. The systems incorporating heat exchangers have smaller losses of approximately 5%. Some of the new schemes are only applicable with steam generating plants. (auth)

21096

KARLSRUHE NUCLEAR RESEARCH CENTER. CENTRAL POINT OF GERMAN REACTOR RESEARCH. Neue Technik 1, No. 6, 10-20(1959) Oct. (In German)

The program of the German Federal Republic in the field of industrial utilization of nuclear energy is described. The structure and the activities of the Karlsruhe reactor center are described. A view is given about the so called 500 Mw program and the aid of the Federal Government to nuclear industries is discussed. (auth)

21097

REQUIREMENTS FOR CONSTRUCTION FOR REACTOR INSTALLATIONS. ASSUMPTIONS AND EXPERIENCE OF SWISS INDUSTRY. A. F. Fritzsche (Reaktor A. G., Würenlingen, Switzerland); R. Naegelin (Gebr. Sulzer A. G., Winterthur, Switzerland); and A. Robert (Énergie Nucléaire S. A., Lausanne, Switzerland). Neue Technik 1, No. 8, 7-24(1959) Dec. (In German)

An attempt is made to collect material which allows an

evaluation of to-day's prospects of Swiss Industry for entering the sphere of nuclear engineering. The first part is a general review of the particular requirements connected with the design and construction of nuclear reactors. This is followed by a consideration of the characteristics of our industry, with particular reference to the machine industry. On the one hand the importance of the new branch of engineering for our industrial development becomes clear, on the other it is shown that our industry possesses a number of traditional features which point to favorable prospects for competently entering this field. The third part of the article summarizes the specific experience in the construction of reactor plants, which is largely based on the realization of the Swiss Experimental Reactor Diorit at Würenlingen. The large number of individual experiences allow certain principles to be deduced, which appear to be of a basic and thus generally applicable nature. It has been found that many of these principles are corroborated by experience in other countries, from which it becomes clear that one must take pains to profit from the lessons learned for our future efforts. (auth)

21098

CRITICAL AND SUB-CRITICAL EXPERIMENTS. R. W. Meier (Reaktor A. G., Würenlingen, Switzerland). Neue Technik, 1, No. 8, 27-30(1959) Dec. (In German)

The reactor design based on pure calculation from fundamental cross sections is still in an unsatisfactory state. Integral data taken from critical or subcritical experiments form a much better basis. This type of experiment has wide applications particularly to the uniform multiplying medium itself as well as to the investigation of all kinds of perturbations due to the operation and construction of a reactor. The critical experiment provides most of the information required for the reactor design. On the other hand the expenditures are high, since automatic safety devices are absolutely necessary. Subcritical and particularly the exponential experiments provide a method of obtaining much of the information required with the minimum expenditure on materials, shielding and instrumentation. (auth)

21099

THE WÜRENLINGEN INSTALLATION SERVING FOR REACTOR DEVELOPMENT IN SWITZERLAND. H. Albers (Reaktor A. G., Würenlingen, Switzerland). Neue Technik 2, No. 1, 58-62(1960) Jan. (In German)

The reactors, laboratories, and other installations which are in possession of the Institute of Nuclear Research at Würenlingen or which are still at the planning state are briefly discussed. A general view is given about their utilization in the field of reactor development in Switzerland. (auth)

21100

THE OMGR FROM A GENERAL VIEWPOINT. A. Sutter (Atomelektra A. G., Zurich). Neue Technik 2, No. 1, 63-8 (1960) Jan. (In German)

The general physical and nuclear properties of organic compounds as coolant and moderator for power reactors are discussed and compared to water. Their decomposition at high temperatures and under nuclear radiation is described. Thereafter, problems of heat transfer and improvement by nucleate boiling, as well as extrapolations to future OMC-Reactors are analyzed. (auth)

21101

DEVELOPMENT OF INDUSTRIAL GAS-COOLED REACTORS. C. Zangger (Atomelectra S. A., Zurich). Neue Technik 2, No. 1, 69-75(1960) Jan. (In French)

First, an analysis of the limiting aspects of Calder Hall type reactors is presented. This analysis is based on the study of the characteristics of such reactors intended for power production only, presently being built in Great Britain and France. The second part deals with some problems particularly related to this type of reactor and which, to a great extent, have been solved by the construction and operation of the nuclear station of Calder Hall. Finally, the basic concept of the Advanced Gas-cooled Reactor, a prototype of which is presently under construction at Windscale, is introduced in the light of economic requirements. (auth)

21102

EVALUATION OF FISSION PRODUCT INVENTORY, ACTIVITIES, AND DECAY POWER LEVELS IN NUCLEAR REACTORS. W. R. Keagy (Atomelectra, Ltd., Zurich). Neue Technik 2, No. 5, 41-7(1960) May. (In English)

A number of different engineering problems call for the evaluation of the inventory of fission products in the core of a nuclear reactor and for the determination of their activities and decay power levels. The basis on which the problem has been studied is described and the principal investigations that have been carried out are reviewed. These include calculations of the detailed inventories of individual nuclides as well as calculations and measurements of the activities, the decay power levels and the gamma spectrum of the mixed fission products. Results of various studies are presented to illustrate the type of information that is available in the literature and to compare, where possible, the results of one investigator with those of others. An extensive list of references is given. (auth)

21103

METAL–WATER REACTIONS AND REACTOR SAFETY. P. J. Koenig (Atomelectra, Ltd., Zurich). Neue Technik 2, No. 5, 48-54(1960) May. (In English)

In appraising the consequences of a "worst-case" accident of water-cooled reactors, one must consider the possibility that not only will the reactor core be at least partially destroyed by overheating, but also that the molten core metals will react more or less explosively with the coolant. The existing literature is examined to determine under what conditions and to what extent zirconium and uranium have been observed to take part in such metal-water reactions. The corrosion behavior of the two metals is also discussed briefly. Finally, the chemical reactions of zirconium and uranium with water are examined in a simplified manner from the thermodynamical viewpoint. It is concluded that the rate of energy input to the core metals and the degree of dispersion of molten metal that could be expected from a severe reactor accident are not sufficient to render likely an extensive metal-water reaction. Whereas the situation with regard to zirconium has been fairly well investigated, the conditions of the uranium-water reactions have remained relatively unexplored. (auth)

21104

METHOD OF OPERATING NUCLEAR REACTORS. (to U. S. Atomic Energy Commission). British Patent 834,701. May 11, 1960.

A method is presented for the operation of D_2O-moderated reactors for increased utilization of the U^{235} content in fuel. It consists of operating 8 reactors simultaneously, each reactor being fueled with a mixture of reprocessed fuel used in two other reactors in the sequence. The mixtures have sufficient U^{235} to sustain chain reactions and are operated to 6% burnup; the fuel is not discarded until the U^{235} content, compared to that in natural uranium, is 61%,

as compared with 69% for single reactors. The method is generalized for the case of n reactors. (D.L.C.)

21105

IMPROVEMENTS IN OR RELATING TO SUPPORT STRUCTURES FOR NUCLEAR REACTOR FUEL ELEMENTS. John Tatlock and John Alexander Forbes Glass (to United Kingdom Atomic Energy Authority). British Patent 836,043. June 1, 1960.

A device was invented for the support of fuel elements in a fast reactor core in such a way that they are closely nested together, while controlling their displacement and providing more room for coolant flow than can be provided by conventional tube-plate support structures. The invention consists of a nest of tubes with long tubes alternating with short tubes, the tubes being engaged by means of slots and hexagonal faces. (D.L.C.)

21106

IMPROVEMENTS IN MATERIAL HANDLING PLANT, MORE PARTICULARLY PLANT FOR HANDLING NUCLEAR REACTOR FUEL ELEMENTS. Richard Arthur Taylor (to Babcock & Wilcox, Ltd.). British Patent 836,563. June 1, 1960.

A plant is described for handling spent fuel elements from a gas-cooled, graphite-moderated reactor. The plant is constructed adjacent to the reactor; after the elements are removed upwards from the reactor, they are placed in a loading machine on rails, which discharges them down to ground level via a spiral chute. The elements are then loaded into skip hoists and rolled into a pond. The danger of discharging a fuel element where there is no container is eliminated by installing special cut-off valves and electronic warning systems. (D.L.C.)

21107

IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Arthur Shillitto and Norman Dean (to English Electric Co., Ltd.). British Patent 840,882. July 13, 1960.

A graphite-moderated, gas-cooled reactor was constructed having the fuel elements accessible from the bottom of the moderator instead of from the top as in other reactors. The elements are maintained in operating position by spacers and, when their discharge is desired, a gate valve is opened and the elements are lowered by means of guide rods into a discharge machine outside the pressure vessel. The advantages of such a discharging arrangement are that the elements lower themselves by gravity; that, since the gas inlets are in the lower part of the pressure vessel, the discharge is carried out in the coolest region of the reactor; and that control rods are not interfered with on the top of the moderator. (D.L.C.)

21108

METHOD OF COOLING NUCLEAR REACTORS. Kurt Diebner. British Patent 841,533. July 20, 1960.

A method is proposed for cooling a reactor with a mercury–gas mixture. The Hg is used at high pressures and the gas is used to remove heat when the reactor is first started. (W.L.H.)

Power Reactors

21109 AEPSC-623

American Electric Power Service Corp., New York.
ECNG–FWCNG—PROTOTYPE AND FULL-SCALE POWER PLANTS GAS-COOLED REACTOR PROJECT. Progress Report No. 3 [Covering the Period from October 1, 1959 to March 1, 1960]. Mar. 15, 1960. 156p. OTS

The study of the 50 Mw(e) prototype power plant was continued and a preliminary design for a 300 Mw(e) full scale plant was developed to obtain an initial measurement of the long range potential of the concept. The estimated capital and energy costs of this plant compare favorable with those of similar size plants employing other reactor concepts. Studies and revisions to the prototype arrangement were continued in order to further resolve alternate approaches on equipment and to incorporate additional features into the over-all design as they develop. A preliminary selection was made for the steam generators in the CO_2 coolant system. Shielding requirements for the reactor systems were determined and provided for without increasing the size of the containment vessel. Sufficient space was allotted for the radioactive waste disposal system in the base of the containment. A mathematical analysis to study the control response of the reactor-power generation system is being carried out. The construction schedule for the prototype plant was revised to reflect the latest on equipment fabrication, deliveries, and erection procedures. (W.D.M.)

21110 AGN-150

Aerojet-General Nucleonics, San Ramon, Calif.
SULFUR COOLED POWER REACTOR STUDY. Quarterly Report No. 1 for Period October 1, 1959 to January 1, 1960. 11p. Contract AT(04-3)-251, Project Agreement No. 4. OTS.

A literature search was carried out and a summary of reported results are included. Sealed, refluxing sulfur capsules were partially immersed in a temperature-controlled salt bath to maintain constant temperature. The capsules were of Vycor approximately 13 mm ID, 17 mm OD, and 12 in. long. A number of capsules was tested, and the preliminary results are discussed. A schematic of the circulating dynamic heat transfer and corrosion loop is given. (W.D.M.)

21111 APAE-52(Vols. I & II)

Alco Products, Inc., Fort Belvoir, Va.
INSTRUMENTATION AND CONTROLS STUDY FOR SM-1 NUCLEAR POWER PLANT. VOLUME I. R. E. May, O. W. Childs, and J. H. Morrison. 361p. VOLUME II. K. Brown and J. Waldron. 113p. Oct. 1959. Contract AT(30-1)-326. OTS.

Volume II prepared by Stromberg-Carlson, Inc. and Catalytic Construction Co. for Alco Products, Inc.

The purpose of the study was to determine the control and instrumentation deficiencies and the corrective action to be taken to improve the reliability of the SM-1 plant. The scope of the investigation was that of the entire plant instrumentation and controls with emphasis upon the most troublesome areas. Objectives of the study were met by the pursuit of three interrelated projects: (a) evaluation of difficulties caused by existing plant controls and instrumentation; (b) evaluation of existing controls and instrumentation at the SM-1 against modern controls and instrumentation; and (c) full scoping of redesign and replacement of the SM-1 plant controls and instrument. Independent assessments of the nuclear and process instrumentation are given. (W.D.M.)

21112 CEND-62

Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.
NUCLEAR POWERED TANKER DESIGN AND ECONOMIC ANALYSIS. PRESSURIZED WATER REACTOR. Jan. 1960. 480p. Contract AT(30-1)-2379, Task V. (NYO-2860). OTS.

A design and engineering study and economic evaluation of a nuclear propulsion system for a large tanker which employs a pressurized water reactor were made. Design of

the reactor and diagrams of the general arrangement of the ship and the main coolant system flow are given. The 82 Mw(t) two-zone, single-pass reactor which utilizes UO_2 clad in stainless steel can produce a maximum steam flow of 294,484 lbs at 602°F and 615 psig. The main propulsion unit is a cross compound geared steam turbine driving a single shaft. Nuclear parameters of the reactor and reactor control features are discussed. Primary shielding consists of lead and borated water and secondary shielding consists of oil tanks. Plant control and instrumentation and auxiliary systems are described. Fuel handling and core servicing techniques are described. A description of the ship and ship systems is given. Reactor operation under normal and abnormal conditions is discussed, and assessments of the reactor and ship hazards are contained. Economics of the program are discussed. (C.J.G.)

21113 CF-59-11-134

Oak Ridge National Lab., Tenn.

GRAPHITE COMBUSTION HAZARD IN THE EGCR. J. W. Prados. Nov. 11, 1959. 20p. Contract [W-7405-eng-26]. OTS.

Factors influencing the possibility of a fire resulting from admission of air to the core of a high-temperature, graphite-moderated, inert gas cooled reactor are considered. An excessive temperature rise in the core (graphite fire) may result if the rate of heat generation from internal sources exceeds the rate at which heat can be dissipated to the surroundings. Approximate calculations indicate that under several possible conditions of coolant system failure with admission of air to the core, a graphite fire could result. More accurate methods of calculation are outlined. Experimental studies and possible methods of fighting an existing fire are proposed. (auth)

21114 CF-60-7-50

Oak Ridge National Lab., Tenn.

APPR-1 STARTUP ANALYSIS. R. S. Stone. July 19, 1960. 5p. Contract [W-7405-eng-26]. OTS.

The Army Package Power Reactor (APPR-1) control system was analyzed to find its response to a startup accident. The system was found to be adequate, at 0.086%/sec rod withdrawal, for operation of at least twice the rated power. (C.J.G.)

21115 CF-60-7-61

Oak Ridge National Lab., Tenn.

PRESSURE RISE IN THE REVERSED FLOW HRT FOLLOWING A COLD FLUID ACCIDENT DURING STARTUP. L. L. Bennett and S. Jaye. July 20, 1960. 11p. Contract [W-7405-eng-26]. OTS.

The maximum pressure rise in the core of the Homogeneous Reactor Test following a cold water accident during startup was calculated for upward flow of core fluid and for reversed flow. With the reactor initially critical at 260°C and a power level of 0.04 w, fuel solution at 100°C was considered to enter the core at a flow rate of 150 gpm. With reversed flow this added reactivity at an average rate of 1.7% Δk_e/sec, while with upward flow the rate was 0.67% Δk_e/sec. The core pressure increased rapidly to a maximum of 550 psi above normal operating pressure with reversed flow and 400 psi with upward flow when only the core pressurizer was available for fluid expansion. With the core and blanket pressurizers connected, the excess pressures were 375 and 210 psi, respectively. (auth)

21116 DANATOM-02-60

Danish Assn. for Industrial Development of Atomic Energy, Hellerup.

N. T. ALPHA–S. T. ALPHA– M. T. ALPHA. THREE 65000 DWT TANKERS—A COMPARATIVE DESIGN STUDY. June 1960. 112p.

A comparative design study was made on three 65,000 DWT tankers, all with 25,000 to 27,500 s.h.p. propulsion machinery. The three vessels were N. T. Alpha, equipped with a Pressurized Water Reactor; S. T. Alpha, equipped with conventional boilers and steam turbine; and M. T. Alpha, equipped with a diesel engine. Several reactor systems were proposed, but only one, the Pressurized Water Reactor, had proved its ability for marine operation. In the N. T. Alpha design, the reactor room was placed immediately forward of the engine room. Most of the system was arranged within a spherical containment vessel of 15.5 m diameter, surrounded by a second shield of concrete and lead. The reactor design was the thermal, heterogeneous type. It was cooled by pressurized light water which also acted as a moderator. The fuel, 4.5% enriched uranium dioxide, was contained in 5,328 stainless steel tubes forming the reactor core. The core was housed in a cylindrical steel pressure vessel with an inside diameter of 2.2 m and an inside height of 5.9 m. A pressurizer maintained a pressure of 106 atm abs at the reactor outlet. Boron stainless steel absorber rods were used for control. The reactor was shielded by a cylindrical water filled steel tank. The cooling water flowed through three parallel coolant loops, with two heat exchangers on each loop, and a small percentage continually passed through a purification system. The reactor plant, the steam system, the main turbine, all other equipment inside the containment vessel, and the main electrical switchboard were designed to be controlled and monitored from the control room at the upper deck. Building costs were calculated and owner's transportation costs for N. T. Alpha and its conventional counterparts were compared. (M.C.G.)

21117 GA-1183

General Atomic Div., General Dynamics Corp., San Diego, Calif. and General Dynamics Corp. Electric Boat Div., Groton, Conn.

MARITIME GAS-COOLED REACTOR PROGRAM. QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING SEPTEMBER 30, 1959. 205p. Contract AT(04-3)-187. OTS.

Reactor Development. Studies were continued on a prototype design which incorporates an outlet gas temperature of 1,300°F and a graphite-moderated, graphite-reflected system. Further studies and evaluations showed that in both over-all efficiency and economy, a BeO-moderated system is superior to a graphite core. Studies are also being made of the problems of fuel loading and handling equipment and reactor controls and instrumentation. The air-flow test stand for simulating the operation of a fuel element was used to test several 19-rod bundles, and the hot channel factor for various conditions was calculated. Other work included measuring the thermal conductivity of various insulating materials in a helium atmosphere, investigating the feasibility of using water, in place of inlet gas, as an emergency coolant for a graphite system, and testing a high heat flux heater for the future thermal mark-up of the fuel element. A series of thermal-cycling tests was run to determine the most reliable type of fuel pellet and cladding assembly. Fluid Systems and Plant Arrangement. Revision and condensation of the system transient equations were continued. Analysis of the heat-transfer test data is continuing. A further study of the tolerable impurity level for a He-cooled graphite-moderated core was made. Rotating Machinery. The analysis of the turbine flow path was completed. A second-series program involving the testing and evaluation of

seals, bearings, and systems which are simplified and improved versions of those tested in the first-series tests was initiated. Tests of six lubricating oils were completed during the quarter. Reactor Physics. The transient temperature behavior of the fuel in the MGCR critical facility was investigated. A survey of cores was undertaken in order to compare BeO and graphite as moderators and to perform a preliminary optimization of the BeO reactor. Materials Development. A general survey of the U—O—Al ternary system is nearing completion. Problems concerning the staining of the matrix in Al_2O_3–UO_2 fuel bodies during sintering and the effect of other additives on the sintering behavior of high-purity alumina were investigated. Work on metal-graphite reactions is reported. A number of creep tests were run on Inconel. (For preceding period see GA-1099.) (W.L.H.)

21118 HW-63576(p.55-60)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
LATTICE PARAMETERS FOR THE EXPERIMENTAL GAS COOLED REACTOR. P. F. Nichols. p.55-60 of NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959.

Measurements of k_∞, f, p^{28}, and ϵ were performed in the PCTR in support of the EGCR program. The EGCR fuel element is a seven rod cluster of 1.8% enriched UO_2 with stainless steel cladding. Stainless steel spiders and end caps are on each end of the fuel element. The lattice spacing is eight inches. The values for a nonabsorbing atmosphere were obtained for the 21.875-inch cell used in the PCTR measurements, and these results were extrapolated to values for a 29.000-inch cell, which is the actual EGCR cell length. (auth)

21119 HW-63576(p.61-4)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
EGCR LATTICE RADIAL AND ANGULAR POWER DISTRIBUTION. P. F. Nichols. p.61-4 of NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959. (HW-63585).

One of the problems encountered in the design of the EGCR has been the possibility of bowing in the outer six rods of the seven rod cluster. The power distribution in an outer rod is asymmetrical with respect to the center of the rod. This causes a variation in the cladding temperature, and might result in uneven thermal expansion, or bowing. Two detailed flux traverses were made on the EGCR lattice in the PCTR to obtain data needed to solve this problem. A detailed (r,θ) flux traverse was obtained for both the center rod and an outer rod in the seven rod cluster. An axial flux traverse was made in the same two fuel rods with simulated spacers in position on the cladding at the cell center line. The purpose of the spacers is to physically restrain the rods from bowing. (auth)

21120 IDO-19009(Vol.I)
Combustion Engineering, Inc. Nuclear Div., Idaho Falls, Idaho.
ABWR QUARTERLY PROGRESS REPORT FOR OCTOBER 1 TO DECEMBER 31, 1959. VOLUME I. SL-1 OPERATIONS AND EVALUATION. Jan. 15, 1960. 78p. Contract AT(10-1)-967. (CEND-66(Vol.I)). OTS.

During the report period the SL-1 plant suffered 10 unscheduled shut-downs: four were the result of steam leaks, two resulted from instrumentation, and two were caused by turbine governor malfunction. Rod bank positions were obtained for various xenon conditions. Decay heat removal tests established that the system pressure buildup would not result in relief valve lifting following a scram and complete loss of power. The shield cooler performance was evaluated. Four nuclear power level channels were calibrated against a reactor thermal heat balance. The process flow diagrams were completed and equipment specifications were prepared. A filter was installed in the branch feedwater line for rod sealing and cooling to prevent crud accumulation in the control rod drive labyrinth seals. An instrument to permit hot calibration of the reactor water level instruments was constructed. The feedwater control system was modified to single element control. (See also IDO-19006.) (W.D.M.)

21121 IDO-28550
Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. THE ML-1 DESIGN REPORT. May 16, 1960. 154p. Contract AT(10-1)-880. OTS.

The ML-1 is to be the prototype of a mobile, low-powered nuclear power plant intended to furnish electrical power in remote locations. It is to be transportable by several types of aircraft, ship or barge, railroad flatcar, and on standard Army trailers. The ML-1 is a high temperature, gas-cooled, water-moderated reactor coupled to compact power conversion equipment. This closed-cycle gas-turbine power plant will have an electrical power generating capacity of 300 to 500 kw. The design is reported in detail. The ML-1 will be installed at NRTS early in 1961, and initial criticality is scheduled for April of that year. (auth)

21122 LAMS-2438
Los Alamos Scientific Lab., N. Mex.
QUARTERLY STATUS REPORT ON LAMPRE PROGRAM FOR PERIOD ENDING MAY 20, 1960. Samuel Glasstone, comp. and ed. June 1960. 64p. Contract W-7405-eng-36. OTS.

With the initiation of the LAMPRE Program Quarterly Report the opportunity is taken to review the objectives of the program as well as to summarize its present status. The program can be conveniently divided into two separate but related phases. The first is concerned with the design and construction of the first reactor experiment, called LAMPRE I. The second involves problems of specific interest for LAMPRE I as well as to the general class of molten plutonium fueled reactors. A general description, core parameters, reactor and plant configurations, and general status of LAMPRE I are given. Current progress is reported in terms of capsule certification tests, sodium system, fuel element storage, and LCX III measurements. The research and development work in support of the LAMPRE program includes Na loop (heat exchanger) studies, fuel alloy development, container alloy development, core concept studies, nuclear physics calculations, mechanical fabrication and welding development, corrosion studies, liquid fuel handling and circulating experiments, fission gas studies, mobile blanket development, and fuel processing experiments. A fairly complete account of the various lines of development at the present time is contained. (W.D.M.)

21123 MND-C-2202
Martin Co. Nuclear Div., Baltimore.
ANPP CODE DEVELOPMENT PROGRAM PRESSURIZED WATER TASK QUARTERLY PROGRESS REPORT No. 3 [FOR] FEBRUARY 1, 1960 TO APRIL 30, 1960. T. M. Olsen, L. Welshans, and C. Eicheldinger. May 1960. 142p. Contract AT(30-1)-2431. OTS.

Progress for the third quarter of the ANPP Code Development Program is reported. SNK transport flux equa-

tions were added to the SYNFAR physical model as an alternate option to the existing Pl-diffusion theory equations, and assembly and checkout of the corresponding subroutines were started. The existing cell correction physical model was verified experimentally. The SYNFAR slowing-down subroutine dynamic flux and reactivity additions were checked out. Also checked out were the options of region dependent buckling, Todt buckling, spherical geometry, Behren's correction, and Couveyou-Macauley moderation. Codes WANDA-3, CANDLE, MUFT-4, and TURBO were tried successfully, using the IBM-709 compatibility option. CELCOR input and mixture cross-section generation subroutines were checked out. The CSDP Program was placed in production, and SCAT and XIMU Programs were checked out. Programs SYNFAR, DELTA, Breit-Wigner Formula, XIMU, and CSDP were added to the APWRC Library Tape. Basic cross section data reduction was completed for 41 materials and the results placed on magnetic tape. Critical experiments were performed on Cores 452, 450, and 354 during the period. The results of thermal buckling measurements and intracell thermal activations on Core 453 are also reported. Improvements were made in the thermal activation measurements, and the intracell measurements were made in greater detail. A new experiment was performed on several cores, which involved thermal activation measurements in the reflector region. Some comparisons of the experimental results from the 45-mil cores are presented. A significant improvement in the fabrication technique for the Type I homogeneous element was achieved through use of fine mesh materials in the pressing blend. SYNFAR was used to predict the results of the PMZ-1 critical experiment. (For preceding period see MND-C-2201.) (auth)

21124 NAA-SR-3573

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

EVALUATION OF CALANDRIA, THIMBLE, AND CANNED-MODERATOR CONCEPTS FOR SODIUM GRAPHITE REACTORS. G. L. Reed. June 10, 1960. 64p. Contract AT-11-1-GEN-8. OTS.

In efforts to improve the neutron economy and lower the capital costs of sodium graphite reactors, several methods of separating the sodium and graphite were investigated including the calandria, the thimble, and the canned moderator reactors. An analysis including nuclear, heat transfer, and economic comparisons was made of these SGR concepts. Based upon neutron economy and feasibility of core fabrication, the calandria concept appears to offer the greatest potential for improvement in SGR design. The thimble concept provides some improvement in neutron economy but introduces numerous problems requiring developmental work. (auth)

21125 NAA-SR-4529

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

FUEL BURNUP STUDIES FOR A 225 Mwe ADVANCED SODIUM GRAPHITE REACTOR. A. L. Aronson. June 15, 1960. 69p. Contract AT-11-1-GEN-8. OTS.

Reactivity and fuel burnup studies were performed for a 255 Mw(e) sodium-graphite reactor of the advanced calandria core type. This reactor is briefly described. Initial criticality calculations and flux distributions were obtained, using two-group theory for enrichments between 2.0 at.% U^{235} and 4.0 at.% U^{235}. A four-group burnup study was performed for enrichments between 2.5 at.% U^{235} and 3.25 at.% U^{235}. Core lifetime, changes in isotopic fuel composition, variations in radial power distribution, and fuel cross sections are presented. Reactivity during core lifetime was assumed to be controlled by the presence of a homogeneous poison which simulated the effects of control rods. The results presented are useful in determining initial enrichment selection in fuel programming and fuel cost studies. (auth)

21126 NAA-SR-4535

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

STRESS ANALYSIS OF HNPF LOADING-FACE SHIELD. R. D. Chipman, M. D. Lynch, and R. M. Peterson. June 30, 1960. 50p. Contract AT-11-1-GEN-8. OTS.

Experimental stress analysis was performed on design aspects of the loading-face shield not amenable to theoretical analysis. Strain and load data obtained from deflection tests of an aluminum model were used to derive bending stress coefficients for different sections of the shield; maximum strains were recorded at inner edges of moderator-removal holes. Concrete specimens in which process-tube hole patterns were reproduced were tested in compression; strain concentration factors as high as eight were recorded. Sleeves of practical proportions were found to be ineffectual in reducing diametric shortening of the holes. Transverse deflections of a plaster scale model were found to be $2\frac{1}{2}$ times greater than predicted by plate theory. On the basis of these investigations, maximum stresses in loading-face-shield concrete and steel were determined and factors of safety were calculated. Results of this analysis indicate that the shield will fulfill service requirements. (auth)

21127 NAA-SR-Memo-2484

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

ORGANIC ENERGY ABSORPTION IN OMRE AND IN METAL AND UO_2 FUELED OMR. V. Keshishian. May 1, 1958. 16p. OTS.

The fraction of total fission energy absorbed by the organic moderator and reflector, terphenyl, in the OMRE and in both a metal and UO_2 fueled 45.5 Mw (thermal) OMR was determined assuming a temperature of 550°F. Qualitatively, it was found that the fraction of energy absorbed by the organic decreased with an increase in operating temperature. The percentage of total fission energy absorbed by the organic in the OMRE was 10.3%, 4.9% in the metal fueled OMR, and 4.3% in the UO_2 fueled OMR. The sources of energy considered were fast neutrons slowing down, gamma rays produced by radiative capture in core and surrounding regions, prompt fission gammas, and gamma rays emitted by fission products. (M.C.G.)

21128 NAA-SR-Memo-4302

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

POWER FLOW COMPARATOR (2nd Interim Report). H. Schlein. Aug. 19, 1959. 6p. OTS.

A circuit that determines safe or scram conditions for the Hallam Power Reactor was constructed and tested with successful results. The circuit continually monitors sodium outlet temperature, total sodium flow, and neutron flux levels. (C.J.G.)

21129 NAA-SR-Memo-4372

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

TEST PROGRAM FOR HNPF PROTOTYPE FREE SURFACE PUMP. R. W. Atz. Sept. 14, 1959. 7p. OTS.

A description of tests to be performed on the prototype pump for use in the sodium heat transfer system in the

HNPF is given. The data from these performance tests are to provide information required for pump evaluation. (J.R.D.)

21130 NAA-SR-Memo-5082
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
REACTOR POWER CALIBRATION BY THE SOURCE INSERTION TECHNIQUE. E. L. Zimmerman. Mar. 17, 1960. 9p. OTS.

A technique for calibrating reactor power by a source insertion technique in terms of watts of power was developed. The theory of the technique is explained. (C.J.G.)

21131 NAA-SR-Memo-5145
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
FLUX MEASUREMENTS IN THE PIQUA OMR CRITICAL ASSEMBLY. R. J. Tuttle. Apr. 5, 1960. 18p. OTS.

Axial flux measurements were made near the central fuel element of the Piqua Power Reactor critical assembly, both with and without a partially inserted control rod in the element. The gross radial flux and intracell flux distributions were measured under the same conditions. (C.J.G.)

21132 NAA-SR-Memo-5158
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
ANALYSIS OF OMRE WASTE GAS. H. M. Gilroy. May 15, 1960. 34p. OTS.

The waste gas from the Organic Moderated Reactor Experiment (OMRE) purge system was analyzed for composition, removal rate, and gross radioactivity during the period from March 21, to November 11, 1958 at high boiler content from 8.5 to 42% and power level from 0.6 to 9.6 Mw. The hydrogen varied from 56 to 98%. The remainder of the gas was hydrocarbons, methane through butane. The measured gas generation rate ranged from 5 to 58 standard cubic feet per megawatt day. The extreme values measured for G_G (number of molecules formed per 100 ev absorbed in the moderator) were 0.007 and 0.112. The steady state value for G_G measured at 600°F and 30% HB was 0.025, which was higher by a factor of 10 from the values obtained in other experiments. The gross radioactivity was only determined on a relative basis and was found to increase by a factor of 480 with an increase in OMRE power from 0.6 to 6 Mw. The waste gas composition changed with high boiler content, the percentage of hydrogen decreasing with increasing percentage of high boilers. The gas removal rate, scfm, increased with increasing high boiler content. The radioactive isotopes identified in the OMRE waste gas were Argon-41, Xenon-133 and Xenon-135. Mass spectrometer analysis of the nitrogen purge gas used in the OMRE showed 0.015% argon present. The specific activity of the OMRE waste gas before dilution in the stack was calculated assuming all the activity present was due to argon and xenon. The activity of the waste gas was found to be from 2×10^{-4} to 2×10^{-6} μc/cc before dilution in the stack. The waste gas analyzer console was demonstrated to be a valuable addition to OMRE instrumentation. (auth)

21133 NAVSHIPS-93393A
New York Naval Shipyard. Material Lab., Brooklyn.
BUREAU OF SHIPS MANUAL: COUNTING TECHNIQUES, PROCEDURES, AND INSTRUMENTATION FOR MEASURING THE ACTIVITY OF RADIOACTIVE SAMPLES ABOARD NUCLEAR-POWERED SHIPS. Charles Christianson and Ralph C. Maggio. June 1960. 203p.

A manual on the measurement of the activity of radioactive samples aboard nuclear-powered ships is presented which contains an equipment description, operational theory and procedures, counting techniques, and instrument maintenance. Procedures are presented for measuring gaseous activity in air and primary coolant; degassed primary coolant, boiler water, and potable water activity; and I and Sr fission-product activity. (C.J.G.)

21134 ORNL-2929
Oak Ridge National Lab., Tenn.
GAS COOLED REACTOR PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1960. June 21, 1960. 274p. Contract W-7405-eng-26. OTS.

Reactor Physics: In EGCR design studies, the energy deposition in the core graphite was calculated for the initial reactor loading with the experimental tubes empty. Calculations of the shutdown worth of the EGCR control rod bank were made. An investigation was made of the neutron flux and power density perturbations produced by a half-empty fuel channel in the EGCR. In advanced design studies, the effect of Pa^{233} absorption on the conversion ratio in a BeO-moderated reactor was calculated. The one-region reactor considered uses Th^{232} as fertile material and U^{233} as fuel. Conversion ratios obtainable in a BeO-ThO_2 blanket were compared with those obtainable in a blanket composed of graphite and ThO_2. In order to compare the nuclear characteristics of BeO- and graphite-moderated cores, multigroup calculations were made for a two-region reactor consisting of a cylindrical core containing a homogeneous mixture of U^{233}, Th^{232}, and moderator surrounded by a cylindrical blanket containing the same moderator mixed homogeneously with Th^{232}. Reactor Design Studies: Several alternate designs for the EGCR fuel element spacers and the top and bottom spiders are being considered. The original "H" structure was found to cause serious maldistribution of the flow. Preliminary analyses of a new design indicated considerable improvement in the flow distribution. An analytical model that describes the flow distribution in a rod cluster was derived that agrees well with experimental results. The effects of fission-gas pressure buildup in fuel elements under various conditions were studied in relation to the behavior of fuel element cladding. The two fuel loading schemes that have been considered for the EGCR were studied in terms of the effects on fuel element surface temperatures. Preliminary design studies of the EGCR control rods were completed. Studies of the deflections and stresses in the cladding of the EGCR fuel elements were continued. The central restraining forces and the deflection profiles were also obtained as functions of time for mean temperatures of 1200 to 1600°F and diametral temperature differences of 25 and 50°F. Equations were developed for thermal stress analysis of anisotropic material subjected to an axisymmetrical temperature distribution. A mathematical model was developed for a seismic analysis of the EGCR. Methods for decontaminating the EGCR charge and service machines were studied. Design criteria were established for the EGCR helium purification system. The existing data on the diffusion of fission products from UO_2 were evaluated. A preliminary study showed that a possibility of graphite combustion in the EGCR exists in the event of accidental admission of air to the main coolant system. Heat Transfer and Fluid Flow: The investigation of heat transfer in the septafoil geometry was continued for the situation of tubes restrained at the mid-plane to the design position and a modified inlet configuration. Preliminary determinations of mass-removal patterns in the vicinity of the mid-cluster spacer were attempted with the use of a modified profilometer. Velocity profiles were redetermined in a septafoil for a $\gamma = 2$ tube spacing following corrective modification of the apparatus, and the velocity contour obtained appeared

to be more symmetrical than those measured originally. Metallurgical Investigations: The fabrication of special UO_2 specimens for irradiation was continued. Tests of stabilized CrO_2, which was proposed for use as a thermal insulator around UO_2 pellets, showed the material to be unsatisfactory. The ZrO_2-UO_2 couples tested showed reaction by diffusion and then by swelling and distortion. Work continued on the development of a low-cost production process for the fabrication of UO_2 fuel bodies. An apparatus was built for determining the thermal conductivity of UO_2. The dimensional stability and mechanical behavior of 95%-dense hollow UO_2 pellets in stainless steel tubes were studied in tests in which the pellets were heated internally to simulate the thermal gradients expected in operation in the EGCR. A series of measurements was made of rates of release of Kr^{85} or Xe^{133} from small specimens of UO_2 at high temperatures after irradiation at low temperatures to a low burnup. Techniques for fabricating high-density low-porosity graphite bodies are being developed that will be adaptable to the production of fueled graphite specimens. The rate of reaction of UO_2 and graphite is being determined as a function of temperature, UO_2 particle size, and pressure. In preliminary tests it was found that the major carbide phase present after the samples were quenched from test temperatures of 1320 and 1425°C was UC_2, but small amounts of UC were found. The time-dependent mechanical properties of graphite at 750 and 1100°F were investigated. Low-density pure BeO and high-density $BeO-UO_2$ and $BeO-UO_2-ThO_2$ bodies were studied as materials for advanced gas-cooled reactors. The creep of type 304 stainless steel in various environments was studied at temperatures up to 1700°F. Experimental studies of the reactions of type 304 stainless steel with CO and CO_2 showed that, with CO at a pressure of 1 atm, carburization is inhibited by the formation of an adherent graphite surface film. It was also found the carburization in flowing CO_2 could be prevented by carefully removing all CO, but amounts as small as 0.1% led to extensive carbon pickup. Tube-burst tests of seamless, 0.020-in.-wall, type 304 stainless steel capsules in various environments were continued, and annealed capsules were tested in air to determine the effect of mid-plane spacer brazing. Synthetic weld-heat-affected zones in type SA-212, grade-B, pressure vessel steel were prepared by cycling specimens to 1400 and 2400°F with an energy input of 50 to 100 kj/in. Fifty EGCR fuel elements were manufactured and inspected to confirm the fabricability of the design and obtain estimates of the assembly time. Methods of joining the burst-slug-detection tubes and thermocouples to the reactor vessel nozzles were developed and are being tested by construction of mockups simulating the reactor design. A study of the reaction of Be with CO_2 at low pressures and at temperatures up to 1000°C showed the rate curve to be parabolic. The compatibility of stainless steel and Be in a NaK environment was studied to assist in the design of capsules for studies of the effect of irradiation on Be tubing. An investigation of the variables in the extrusion process for producing Be tubing was initiated. The joining of Be tubing by fusion welding was successful only with tubing machined from hot-pressed material. Brazing and diffusion bonding are the more successful methods tried to date. Several alloys suitable for brazing are available, and leaktight brazed joints in capsules were prepared. Several diffusion-bonded joints prepared in helium or vacuum showed complete grain coalescence and were leaktight. A number of thermal-cycling tests were run on Be specimens from various sources. In-Pile Testing of Components and Materials: The second group of eight full-diameter prototype EGCR fuel capsules is being irradiated. New estimates of the total burnups for the first group of similar capsules were prepared. New ceramic-insulated miniature capsules were designed for use in fission-gas-release experiments. The insulating material is depleted UO_2. Irradiation of two graphite-clad UC_2-graphite matrix fuel elements in the MTR was completed. Examinations were made of the first group of ORR-irradiated full-diameter prototype capsules. Data obtained recently on fission-gas release from LITR-irradiated miniature pellets are presented. Postirradiation examinations of the GETR-irradiated capsules were completed, and ceramographic studies of the fuel are under way. Data are being obtained in the instantaneous fission-gas-release experiment for an assembly that consists of two thin plates of high-density UO_2 with thermocouples sandwiched between them on the outer surfaces. Preparations are being made for experimental investigations of the effects of radiation on structural metals, in particular, steel and beryllium. Analyses were made of data obtained in in-pile tube-burst-type stress-rupture tests of Inconel, and an explanation for the shorter time to rupture under irradiation was postulated. Out-of-Pile Testing of Materials and Components: Analyses of the results of isothermal tests of graphite and structural materials in static helium showed the effect of temperature on the reactions of the graphite and the metals with the impurities produced by the outgassing of the graphite. In experimental studies of the evolution of gases from graphite, two grades of graphite, R-1HLM and R-6HLM, obtained from the Great Lakes Corporation have been tested. Silicon-silicon carbide coated graphite specimens evolved surprisingly large volumes of gas when heated from room temperature to 1000°C. Experimental studies of the interdiffusion coefficients of noble gases in graphite were continued. The expected state of combination at equilibrium for all products of fission of UO_2 with yields above 0.1 atom per 100 fissions was predicted from available thermodynamic data. In the study of the measurement of high temperatures, a procedure was developed for using the Oracle to make the calculations required to predict the variations of cooling corrections with the cooling conditions surrounding thermocouples. Tests on Chromel-Alumel thermocouples in the presence of chromium, Inconel, and quartz in a flowing helium atmosphere showed no fast emf drifts when there is limited access of the helium to the wires in the thermal-gradient range. The effect of helium carrier gas pressure on the dynamic adsorption of krypton by charcoal at 25°C was studied experimentally, and preliminary tests were made of a number of samples of commercially available activated carbons with respect to fission-gas retention. Development of Test Loops and Components: Installation work on GCR-ORR loop No. 1 was started, and the design of loop No. 2 was approximately 70% completed. Data required for and analog simulator study of loop No. 2 operation were assembled, and design conditions were determined for tests of graphite-clad fuel elements. Design criteria were developed for the helium- and CO_2-cooled experimental loops in the EGCR. A grease-lubricated centrifugal compressor satisfactorily completed a 3000-hr endurance test while operating at 12,000 rpm with helium at suction conditions of 590°F and 400 psig. Performance data were obtained during 150 hr of continuous operation of a prototype regenerative compressor at 9000 rpm with helium at 385 psig and 600°F. (For preceding period see ORNL-2888.) (W.D.M.)

21135 ORNL-2947
Oak Ridge National Lab., Tenn.
HOMOGENEOUS REACTOR PROGRAM QUARTERLY

PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960. Aug. 9, 1960. 147p. Contract W-7405-eng-26. OTS.

Research activities are reported on in terms of the Homogeneous Reactor Test reactor analysis and engineering development, solution fuels, slurry fuels, fuel manufacture, metallurgy, and analytical chemistry. Separate abstracts were prepared for the seventeen major sections of the report. (For preceding period see ORNL-2920.) (W.D.M.)

21136 ORNL-2947(p.3-14)
Oak Ridge National Lab., Tenn.
HRT REMOTE OPERATIONS, MAINTENANCE, AND TESTING. S. E. Beall, P. N. Haubenreich, J. W. Hill, Jr., I. Spiewak, W. R. Gall, F. N. Peebles, M. I. Lundin, et al. p.3-14 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

A program of major reactor alterations and repairs was initiated after run 21, which was concluded when a second hole formed in the Zircaloy core vessel. The program is now approximately 60% complete. The upper five core diffuser screens were removed from the core, plastic impressions of the core holes were made to aid in patching them, and several major pieces of reactor equipment were replaced or altered. Tools were prepared for cutting a sample of the core wall from around the second hole, for taper-reaming the circular opening left by the sample, for cleaning the core wall, and for plugging the two holes. Helium leak detection was used to locate a crack that occurred in the purge line of the core circulating pump during run 21 shutdown. Reactor containment-shield penetrations are being leak tested to ensure that the integrity of the shield is maintained. (auth)

21137 ORNL-2947(p.15-17)
Oak Ridge National Lab., Tenn.
HRT PROCESSING PLANT. W. D. Burch and O. O. Yarbro. p.15-17 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

A revised multiple-hydroclone system was designed and is being fabricated for installation prior to the next run. The efficiency was improved by using more hydroclones (18 instead of 13) and by using a smaller, more efficient size; by utilizing the full head of the circulating pump (for increased pressure drop); and by recycling overflow from the cell-C collecting hydroclone to prevent loss of solids from that unit. A gamma survey of reactor cell piping 80 days after shutdown indicated that about 85% of the insoluble fission-product activity remained in the high-pressure system. The highest reading found exceeded 6000 r/hr and was at the multiclone feed chamber. Piping in the high-pressure system read from 800 to 3900 r/hr. The dirt trap in the suction line to the fuel feed pump, which read 1100 r/hr following run 13, was only 120 r/hr at this survey. (auth)

21138 ORNL-2947(p.18-21)
Oak Ridge National Lab., Tenn.
HRT COMPONENT DEVELOPMENT. I. Spiewak, F. N. Peebles, et al. p.18-21 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

The ignition of a titanium wear ring while operating in a pump circulating high-pressure oxygen caused a burn-through of the stainless steel discharge pipe. Such fires can be avoided by the use of adequate wear-ring clearance, and particularly by stopping the pump upon a low-power signal caused by the presence of gas. A stress analysis of the HRT core indicated that operation of the core and blanket at widely differing temperatures will not cause excessive stresses in the core tank. Flow tests, coupled with computations of nuclear heating, indicated that the HRT in reverse flow will operate with a maximum core wall temperature of 300°C, if no scale is deposited. The maximum interior temperature is expected to be 305°C. (auth)

21139 ORNL-2947(p.22-4)
Oak Ridge National Lab., Tenn.
HRT REACTOR ANALYSIS. P. R. Kasten, M. L. Tobias, and D. R. Vondy. p.22-4 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

A study was made of the critical concentration in the HRT at 260°C, with various blanket fuel concentrations; harmonics-method results and two-group and multigroup results were in good agreement. With blanket-to-core fuel-concentration ratios of zero and 0.4, the clean-core critical concentration was 6.9 and 4.7 g of U^{235} per liter, respectively. Addition of poisons presently within the system increased the fuel concentration about 2%. Changing the fuel from U^{235} to U^{233} with no fuel in the blanket decreased the critical concentration from 6.9 to 5.5 g/l. (auth)

21140 ORNL-2947(p.27-8)
Oak Ridge National Lab., Tenn.
REACTOR ANALYSIS. P. R. Kasten, M. L. Tobias, and D. R. Vondy. p.27-8 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

Estimates were made of the core critical concentration in small, cylindrical reactors; the core region contained UO_2SO_4-D_2O, while the blanket region consisted of three discrete thoria-pellet regions containing 5300 g of Th per liter, separated by D_2O regions. With a core diameter of 18 in. and a length of 48 in., and with 7.5 in. of D_2O separating the core from the first thoria-pellet region, the fuel concentration at 280°C for a clean core was 17.4 g of U^{233} per liter. Keeping other thicknesses constant, decreasing the thickness of the first D_2O gap from 7.5 to 4 in. increased the core critical fuel concentration by 40%. Increasing the core length from 48 to 72 in. decreased the critical fuel concentration about 17%, while increasing the core diameter from 18 to 21 in. decreased the core concentration by about 35%. (auth)

21141 ORNL-2947(p.29-41)
Oak Ridge National Lab., Tenn.
DEVELOPMENT OF REACTOR COMPONENTS AND SYSTEMS. I. Spiewak, F. N. Peebles, et al. p.29-41 of HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1960.

A cylindrical core model 2 ft in diameter and 6 ft long was operated. The first set of entry vanes tested promoted bypassing of about half the fluid from inlet to outlet, so that new vanes were designed and fabricated for test. An evaluation was made of two-region thoria breeders which indicated that blankets containing stationary thoria pellets are quite promising. Detail design was begun of an experimental model simulating the blanket of a 40-Mw(th) reactor. Lead shot were circulated in a simple model, illustrating the arrangement proposed for handling blanket thoria. The 200Z pump, containing alumina bearings, continued to operate satisfactorily. A test stator appeared to remain in a useful condition after an irradiation dose of

5.43×10^9 rads, indicating acceptable radiation resistance. The three-stage oxygen compressor was further instrumented in an attempt to determine the cause of persistent diaphragm failures. Increased-capacity solution feed pumps continued to perform satisfactorily. The 300-SM system was charged with slurry, following completion of numerous modifications. Charging was performed easily, and improved valves increased the reliability of the system as a whole. A slurry of 1600°C-fired thoria circulating in the 200B loop appeared to be forming a scale on the heat transfer surface. Its yield stress at elevated temperatures appeared to be unexpectedly low. A correlation derived for slurry nonuniformity in the 200A loop suggested that dilute slurries are less uniform than high-concentration slurries. In the 50A loop, a 3.65-μ thoria slurry retained moderately dilatant properties after circulation. (auth)

21142 RADC-TR-59-235

Blaw-Knox Co. Chemical Plants Div., Pittsburgh.

INVESTIGATION AND STUDY OF PRIMARY LOOP IMPROVEMENTS FOR NUCLEAR POWER PLANTS. Dec. 1959. 121p. Project No. 6135. Contract AF30(602)-2006. (AD-232073).

Design and characteristics of pipe connectors and gaskets, valves, circulating pumps, and pipe material pertaining to the primary loop of a prepackaged nuclear power plant are considered. Limitations of size and weight for air transport, and factors of field assembly and disassembly are discussed. Discussion of primary coolants indicated that the pressurized water or boiling water cycles are preferable for this application. Pipe connectors with related gasket types are discussed. Two-bolt connectors with special forms of metallic gaskets are recommended in preference to standard ASA flanged joints. Zero leakage and controlled leakage valves are described. Valve operating and control systems are discussed, outlining factors of dependability and the effect of total leakage on design of auxiliary water system. Circulating pumps of conventional design with standard or special mechanical seals are discussed and compared with canned rotor pumps on the basis of leakage rates, dependability, maintenance, and cost. Operating experience and test data for both types are reported. Results did not indicate sufficiently reliable and consistent control-led leakage rates to recommend acceptance or preference over canned rotor designs. Simplified flow sheets of pressurized water and boiling water reactor systems are presented; factors affecting corrosion are discussed. Induced radioactivity on the secondary effects on corrosion products is discussed. (auth)

21143 SRO-34

Savannah River Operations Office, AEC.

HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, JUNE 1960. 19p. OTS.

Research and development activities being carried out by duPont, Nuclear Development Corporation, Nuclear Metals, and Sargent and Lundy are summarized. Status of the Heavy Water Components Test Reactor and the Power Demonstration Program research and development tasks is given. (W.D.M.)

21144 TID-3556

Office of Technical Information Extension, AEC.

SELECTED REACTORS OF THE POWER REACTOR DEMONSTRATION PROGRAM. A Literature Search. James M. Jacobs, comp. June 1960. 35p. OTS.

A bibliography of 314 progress and topical reports is given for ten reactors of the Power Reactor Demonstration Program: Elk River, Enrico Fermi, Florida, Hallam, Parr Shoals, Pathfinder, Piqua, Puerto Rico, Saxton, and Yankee power reactors. The reports are grouped by the reactor to which they pertain. (D.L.C.)

21145 TID-5742

Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.

PL-2 DESIGN SUMMARY—1000 KW(e) PORTABLE BOILING WATER NUCLEAR POWER PLANT. [1960]. 19p. OTS.

PL-2, a 1000 kwe Boiling Water Reactor Plant was developed for the generation of electric power at a remote site. The plant is air transportable. The machinery is arranged in modules which are easily erected and are adaptable to a wide range of site conditions, foundations and enclosures. This plant is a refined packaged version of the SL-1 (ALPR) Prototype. The plant incorporates the inherently simple and reliable natural circulation boiling water reactor system. Proven, standard commercial components are used to ensure a high degree of reliability at reasonable cost. The reactor requires refueling only once every four years. A PL-1 Plant with a 200 kwe rating was also developed. Work to date indicates that fully air transportable and modular boiling water plants are a good engineering solution for electric power generation at remote sites for ratings up to at least 2500 kwe. (auth)

21146 TID-5762(Vol. I)

Federal Power Commission. Bureau of Power, San Francisco.

NEW PRODUCTION REACTOR POWER PLANT, ECONOMIC FEASIBILITY STUDY. Feb. 1960. 146p. OTS.

An attempt is made to appraise the economics of adding power producing facilities to the convertible reactor (NPR) now being designed and built at Hanford. Items given special consideration include marketability of NPR power, cost and amount of power available from the NPR power plant and conventional sources, amount and cost of reserves required, and transmission facilities needed, including those pertaining to the length of the Pu producing period and basic U and Pu values for estimating cost of nuclear fuel. (W.D.M.)

21147 TID-8518(Bk. 1)

Atomic Energy Commission, Washington, D. C.

CIVILIAN POWER REACTOR PROGRAM. PART III. BOOK I. STATUS REPORT ON FAST REACTORS AS OF 1959. 1960. 102p. GPO.

A description of fast reactor types is given and the objectives of the AEC program on fast reactors are outlined. General research and development programs completed and in process on physics, fuel and materials, heat transfer, fluid flow, coolant chemistry, reactor safety, and components and systems are discussed. Reactors completed, under design and construction, and under study are described. (W.D.M.)

21148 WAPD-MRP-86

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

PRESSURIZED WATER REACTOR (PWR) PROJECT TECHNICAL PROGRESS REPORT FOR THE PERIOD APRIL 24, 1960 TO JUNE 23, 1960. 134p. Contract AT-11-1-GEN-14. OTS.

Power Plant Support: Equipment for removal of steam generator tubes is required to make thorough materials investigations of the causes for the leaking PWR steam generator tubes. Specifications for the removal equipment were developed. Six heater wells were removed from the pressurizer after 10,500 hours of operation, to determine the extent of caustic stress corrosion. No indication of

caustic stress corrosion was found. Tests made during Seed 2 startup indicated that the reactor protection system time response had not changed significantly over the period of Seed 1 operation. The sensitivity of the radioactive waste disposal stack gas monitor was found to be 10^{-4} to 10^{-5} instead of the desired 4×10^{-6} μc/cc. Reducing the purification flow rate to one-half resulted in no demonstrable change in the trend of long-lived activity buildup in the plant. Use of an inhibitor in conjunction with the APAC decontamination process effected a decrease in corrosiveness but also decreased the decontaminating effectiveness of the process. The functional requirements for the heat dissipation system for PWR Core 2 were developed. The design description for the PWR Core 2 pressurizing and pressure relief system was completed. Reactor Engineering: Visual Examinations have shown sheath defects which could explain observed Seed 1 thermocouple failures. Power capability of Core 1 with Seed 2 installed was reexamined using additional nuclear design information and "as-built" hot channel factors. As a result, the power capability was established as 111% of the nominal 231 Mw for the first 2000 EFPH. During initial operation of Core 1 with Seed 2, measured core thermal parameters were generally as predicted with exceptions noted. Reactor pressure drop observed for the first three weeks of operation showed no significant change. Many of the detailed design features of PWR-2 were finalized, and product drawings of the core structural components and fuel assembly components were completed. A test was initiated to evaluate the effective coefficient of thermal expansion for compartmental oxide fuel plates fabricated by the isostatic pressure bonding process. A change in the design of the mechanism housing was made to facilitate refueling operations. The location of the control rod drive mechanism torque restraint was changed from within the mechanism to the lower shroud. A method of protecting against a control rod ejection in the event of a ruptured mechanism motor guide tube housing was devised, which will meet anti-ejection requirements. A study of the stresses of the blanket fuel compartment showed the present design to be within allowable limits. Metallurgy of Core Materials: Measurements of plate thickness swelling of copper diffusion bonded and pressure bonded plates containing bulk B_4C showed swelling of this material. The swelling noted was apparently a function of the number of B^{10} atoms burned up. Compartmented oxide plate samples displaying excellent bond strength on pressure-burst testing and Type A bond quality on metallographic examination were fabricated by isostatic pressure-bonding using controlled surface preparation and bonding conditions. Boron carbide of high density (98+% T.D.) was prepared by hot pressing both elemental boron and carbon powder mixtures and B_4C powder. Corrosion tests of various batches of ZrO_2–25 wt.% UO_2 platelets, with and without Y_2O_3 additions, showed this composition to be stable to high temperature water. Oxygen ion self-diffusion measurements in $U_{0.9}Y_{0.1}O$ showed a low activation energy (about 19 kcal/mole). Further experiments confirmed earlier results which indicated that Kr^{85} diffusion coefficients in UO_2, calculated from post-irradiation high-temperature anneal data, increase with increased burnup of the oxide. Measurement of the burnup of slightly irradiated B_4C platelets by isotopic analysis for B^{10} confirmed helium release data obtained by diffusion anneals. Reactor Physics: Analysis of clean critical control rod configurations observed for PWR-1 Seed 2 indicated that the calculated critical eigenvalues for Seed 2 were within ½% Δ k/k of those for Seed 1 at the comparable time in seed reactivity life. Preliminary calculations were carried out to explore the possibility of introducing a special subassembly of PWR-2 plate-type UO_2 fuel elements into PWR-1 to provide a test of that material in an operating reactor environment. A comparison was made of calculated and mass spectrographically measured values of the isotopic composition of a UO_2 fuel element removed from the PWR-1 natural uranium blanket after irradiation through the Seed 1 lifetime. Additional studies were made using the detailed two-dimensional depletion model to examine the effects on power peaking resulting from changes in the control rod configuration. A study is in progress to determine the effects on nonuniform axial fuel depletion resulting from the axially varying moderator density associated with power operation. Results were obtained through 8000 EFPH of PWR-2 life. A technique was demonstrated for approximating the effects of spatial variations in the thermal neutron energy spectrum with a one-group model of the thermal neutron behavior. A comparison was completed of the measured and calculated neutron activation distributions in the PWR-2 mockup. Recent calculations showed that the heterogeneous U^{238} resonance integral computed using a Monte Carlo code is somewhat greater than the value obtained using the Stein prescription. The changes are such that the self-shielding factor would be increased from 0.82 to 1.0. The corresponding values of ρ^{28} would then bracket the measured value. (For preceding period see WAPD-MRP-85.) (W.D.M.)

21149 WCAP-1340(Vols. 1 & 2)

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

NUCLEAR POWERED TANKER DESIGN AND ECONOMIC ANALYSIS. INDIRECT CYCLE BOILING WATER REACTOR. G. H. Farbman, G. W. Bond, Jr., L. Chinaglia, G. Inada, E. E. Smith, and W. W. Steffes. Jan. 7, 1960. (Vol. 1, 150p., Vol. 2, 149p.). OTS.

These two volumes were issued separately, but are cataloged as a unit.

A general description of ship and power plant, tabulation of principle characteristics, economics, potential advances, and necessary research and development are discussed in detail. (W.D.M.)

21150

THE AMERICAN HIGH TEMPERATURE REACTOR PROJECT HTGR. F. De Hoffmann, P. Fortescue, and C. Rickard (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Atomwirtschaft 6, 250-3(1960) June. (In German)

The American high-temperature reactor project HTGR is the third high-temperature design to be under construction at the present time. It differs from the British DRAGON project and the German AVR-BBC/Krupp Reactor particularly in the form and arrangement of the fuel elements. The 40-Mw experimental installation is designed as a prototype for larger power stations. For a 325-Mw power plant of the same type, the generating costs are calculated for the United States and Germany. (J.S.R.)

21151

CORROSION AND ACTIVITY BUILD-UP IN A POWER REACTOR. C. Richard Bergen and Julius Chupak (Alco Products, Inc., Schenectady, N. Y.). Ind. Eng. Chem. 52, 699-702(1960) Aug.

The corrosion rate, crud film, and activity build-up were studied for the coolant system of the Army Reactor (SM-1). Descaled corrosion of the coupons in the primary coolant side stream agreed with literature values. High crud levels followed high oxygen concentration in the primary coolant. The film was found to thicken at a decreasing rate, but its radioactivity grew at an increasing rate.

To prevent this activity build-up, inhibiting redeposition of suspended material from the coolant appeared to be more promising than increasing the purification rate. (M.C.G.)

21152

THERMODYNAMIC TREATMENT OF EFFICIENT OPERATION OF WATER ECONOMIZERS OF NUCLEAR POWER PLANTS. T. Kh. Margulova (Moscow Institut für Energetik). Kernenergie 3, 23-37(1960) Jan. (In German)

A thermodynamic treatment and discussion are presented to demonstrate efficient use of water economizers in nuclear power plants. Three cases are considered: boiling water reactor with a single loop and additional steam production, or with high and very-high steam parameters and superheating in the reactor, or with two loops for high and very-high steam parameters. (T.R.H.)

21153

METHOD AND ARRANGEMENT FOR THE PROPULSION OF SHIPS WITH NUCLEAR ENERGY. Kerntechnik 2, 213(1960) June. (In German)

A method for the propulsion of ships with nuclear energy was proposed. In the proposal the nuclear energy plant was placed in a special mother vessel and electrical energy produced for delivery to the ships to be propelled. As principle drive the satellite ships have only electrical traction motors, which are supplied by cables from the ship carrying the nuclear energy plant. They are also supplied with small suitable auxiliary drives since the mother vessel, probably from safety reasons, should remain outside the harbor while the satellite ships can maneuver themselves.

21154

THE DRAGON PROJECT. W. Winkler (Escher Wyss Aktiengesellschaft, Zurich). Neue Technik 1, No. 3, 13-18 (1959) July. (In German)

The Dragon-Project is a high-temperature-reactor. It will be compact in construction. Its coolant temperature will be such that the most modern steam-turbines and possibly also gas-turbines can be used. It will have a high conversion or breeding factor. Its fuel elements will be constructed so as to allow a high burn-up. (auth)

21155

REACTORS AND NUCLEAR FISSION FUELS. AN ECONOMIC VIEWPOINT. K. Hintermann. Neue Technik 1, No. 4, 19-24(1959) Aug. (In German)

A general description of various reactor types is given with particular view to some economic aspects. The different positive and negative properties of these reactors are discussed. The Swiss reactor projects are enumerated and the possibilities of Switzerland in the field of nuclear energy are briefly indicated. (auth)

21156

AUXILIARY SERVICES IN THE WÜRENLINGEN REACTOR CENTER. H. Lienhard (Reaktor A. G., Würenlingen, Switzerland). Neue Technik 1, No. 5, 15-24(1959) Sept. (In German)

The tasks of the auxiliary services in the Würenlingen reactor center in Switzerland are described. (auth)

21157

HEAVY WATER MODERATED REACTORS. P. Ferrarini (Gebr. Sulzer A. G., Winterthur, Switzerland). Neue Technik 2, No. 2, 63-9(1960) Feb. (In German)

The use of heavy water as moderator offers a number of important advantages that was possible to fully realize in the construction of research reactors. Even though up to the present time there were not many opportunities for acquiring practical experience with heavy water moderated power reactors, our knowledge in the sphere of lattice physics gives us the assurance that no insurmountable difficulties are to be expected in the application of heavy water as moderator. An attempt is made to give a general survey of the problems connected with the modern power reactors using heavy water as a moderator. Two different and important spheres of the problem are distinguished, for the nearer elucidation of which a series of relevant recent reports from the United States are cited. The problems on the one hand deal with the reactor core proper, and on the other hand with the plant for the utilization of energy. The fuel for these reactors consists of natural uranium or at the most of lightly enriched uranium, the behavior of the reactor over a prolonged time period being of special interest. In addition to attempts made to improve the best possible attainable values for the burn up, attention should be given to attaining the highest possible medium values for this item. The utilization of energy from the power reactor is accompanied with the question of the cooling medium and its behavior during operation. From comparisons of results of research in this direction carried out in the United States, it would appear that the high pressure boiling water reactor may be considered as being the most favorable variant for the near future. Other possibilities may offer themselves at a future period such as, for instance, using light water vapor or gases for the purpose of cooling. (auth)

21158

SOME REMARKS CONCERNING THE POWER REACTOR PROGRAM OF AEC. Chauncey Starr (Atomics International, Canoga Park, Calif.). Neue Technik 2, No. 3, 46-51(1960) Mar. (In English)

A comment is given on the objectives of the Civilian Power Reactor Program of AEC. After having compared the uranium resources of the United States with their uranium requirements, it is stated that the uranium resources of this country are sufficiently large for the foreseeable future. Then, certain general points of the program of AEC are discussed. Finally, some comment is made on the importance of the use of nuclear reactors for auxiliary power, for both military and non-military space missions. (auth)

21159

FACT SHEETS ON U.S. NUCLEAR POWER PROJECTS. Second Edition, prepared by the Electric Companies Public Information Program. New York, Bozell & Jacobs, Inc., 1960. 52p.

The A.E.C. approach to nuclear power development from the end of World War II to 1960 is briefly outlined, and fact sheets are given for U.S. power reactors: pressurized water reactors (Shippingport, Indian Point, Yankee, Saxton, Carolinas-Virginia), boiling water reactors (EBWR, Vallecitos, Dresden, Elk River, Pathfinder, Humboldt Bay, Big Rock Point), sodium cooled reactors (Santa Susana, Hallam, EBR-2, Enrico Fermi), Piqua organic cooled reactor, and gas cooled reactors (HTRDA-Peach Bottom, EGCR, Florida West). The fact sheets are composed of business details, e.g., contractor, cost, and completion date, but little technical detail other than power output and fuel enrichment. An index by companies is given. (D.L.C.)

21160

A NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 837,769. June 15, 1960.

A reactor was invented for the extraction of both thermal and thermoelectric power from fission reactions. It consists of a core of U^{235} fuel plates sandwiched between constantan and chromel plates and is sodium-cooled. The sandwiches, forming thermocouples with U^{235} serving as

the hot junction and sodium as the cold junction, are arranged in series to form a thermopile for thermoelectric power generation. The thermoelectric power is led to outside loads by electric connections, while thermal power is transferred from sodium to water via heat exchangers. The possibility of using a two-sectioned U^{235} fuel element as a thermocouple by introducing impurities into one section is treated. (D.L.C.)

Research Reactors

21161 ANL-6154
Argonne National Lab., Ill.
TWO-DIMENSIONAL TWO-GROUP CALCULATION OF THE ARGONAUT ONE SLAB LOADING. Don P. Moon. Apr. 1960. 92p. Contract W-31-109-eng-38. OTS.

An attempt is made to set forth in systematic form the two-energy group physics calculations for the Argonaut one-slab configuration. All assumptions are stated and full calculational details given so that the procedure used may be followed. Complete point by point flux values from the PDQ programming of the problem on the IBM-704 are given. A comparison of theoretical and experimental results is included. (W.D.M.)

21162 CF-60-5-109
Oak Ridge National Lab., Tenn.
AN INVESTIGATION OF THE STRUCTURAL INTEGRITY OF SELECTED COMPONENTS OF THE OAK RIDGE RESEARCH REACTOR. J. M. Corum, B. L. Greenstreet, R. L. Maxwell, and M. W. Rosenthal. July 22, 1960. 48p. Contract [W-7405-eng-26]. OTS.

An investigation was made to determine the structural behavior of selected components of the Oak Ridge Research Reactor for increased power level conditions. It was found that a reactor cooling water outlet temperature of 150°F will cause severe plastic strain cycling in the aluminum housings for the large test facilities. Increasing the reactor cooling water flow rate of 22,000 gpm will cause plastic deformations in certain regions of the core box. These latter deformations can be tolerated, but the full implications associated with any change in pressure differential must be understood before adopting the above flow rate. (auth)

21163 HW-63576(p.32-4)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
THE MEASUREMENT OF k_∞ FOR NEGATIVE k_{ex} LATTICES IN THE PCTR. P. F. Nichols. p.32-4 of NUCLEAR PHYSICS RESEARCH QUARTERLY REPORT [FOR] OCTOBER, NOVEMBER, DECEMBER 1959.

A method of utilizing standard techniques for k_∞ lattices is proposed. The method consists of introducing a small volume of a subcritical medium into the void central cavity of the PCTR along with sufficient additional fissionable material such that there is no change in reactivity. (W.D.M.)

21164 TID-8205
Division of Reactor Development, AEC.
SURVEY OF INDUSTRIAL REQUIREMENTS FOR GENERAL TESTING REACTORS FOR THE PERIOD 1960 THROUGH 1965. Oct. 1959. 25p. OTS.

This volume is broken down into three parts. Part one pertains to capsule tests, part two covers loop tests, and part three compares industrial requirements with the capacity of typical test reactors. (W.L.H.)

21165
SOME ASPECTS OF THE DESIGN OF RESEARCH REACTORS OF THE "SWIMMING POOL TYPE." William M. Breazeale. Bol. inform. junta control energía atómica (Peru) 5, 10-36(1960) Mar.-Apr. (In Spanish)

A survey is given of the principal factors in the design of a swimming pool reactor. The factors discussed include reactor physics, fuel elements, cooling and heat transfer, shielding, water treatment and corrosion, controls, operational malfunctions, maximum power level, and mechanical design. 24 references. (J.S.R.)

21166
EXPERIMENTAL FACILITIES OF THE BR-2 REACTOR. II. THE REACTOR CHANNELS. J. Planquart (Centre d'Études pour les Applications l'Énergie Nucléaire, Brussels). Bull. inform. assoc. belge develop. pacifique energie atomique No. 26, 3-10(1960) May. (In French)

The vertical experimental channels of the BR-2 Reactor and their characteristics are described. The construction of the channels is then discussed. Various experimental possibilities at the interior of a standard channel, at the interior of a large channel, and at the interior of a small-diameter channel are next considered. Installation of experiments in the reactor vessel is briefly described. (J.S.R.)

21167
THE SAPHIR REACTOR AT WÜRENLINGEN AND A REVIEW OF ITS USE TO THE PRESENT TIME. J.-M. Pictet (Reaktor S. A., Würlenlingen, Switzerland). Neue Technik 1, No. 1, 13-19(1959) May. (In French)

The first part is devoted to a general description of the characteristic features and the mode of operation of the Würenlingen swimming pool reactor, which is in service since 1957. The second part deals with possible methods of operation in the future, and the facilities offered by this reactor for carrying out experiments and studies regarding future developments. Some of the work already carried out in connection with the Saphir reactor is described, such as: measuring of the reactor functions, studies with regard to shielding, tests of materials, installation of hot loops, and production of isotopes. (auth)

21168
THE AG REACTOR AS THE CENTRAL REACTOR RESEARCH SITE FOR SWISS INDUSTRY. P. Schmid (Reaktor A. G., Würenlingen, Switzerland). Neue Technik 1, No. 1, 30-2(1959) May. (In German)

Versatile research facilities offered by the Würenlingen Reactor Center for the Swiss Industries are described. The first part deals with the general development of the plant and installations of the Würenlingen Reactor Company. The reasons are given for the selection of a heavy water moderated and cooled natural uranium reactor. The work connected with the construction of the plant and the reactor is briefly discussed, with more particular reference to the present state of development. The second part deals with future problems and possibilities of the Würenlingen Reactor Center, with particular reference to the part assigned to the reactor in the future development of the nuclear energy development in Switzerland. (auth)

21169
PHYSICAL DIMENSIONING OF DIORIT REACTOR. R. W. Meier (Reaktor A. G., Würenlingen, Switzerland). Neue Technik 1, No. 2, 7-13(1960) June. (In German)

In order to ascertain the physical properties of the DIORIT reactor by calculation, it is necessary to resolve the prevailing state of the reactor under normal working conditions into basic problems and a series of disturbing factors. To secure reliable information regarding the comparison of results as theoretically calculated with those ob-

tained experimentally when starting the experiment, simple conditions encompassing a uniform grid of 76 uranium rods and a thick D_2O reflector were selected and the problem discussed in detail. The reactivity as a function of the number of rods employed up to the full complement of 256 in the grid is stated. The effect of the irradiation channels, the temperature and poisons can then be calculated as disturbances from the data of this full core. (auth)

21170

REMARKS ON CONSTRUCTION OF DIORIT HEAVY WATER REACTOR. O. Schaub (Reaktor A. G., Würenlingen, Switzerland). Neue Technik 1, No. 3, 6-12(1959) July. (In German)

The two phases in the erection of the diorit heavy water reactor at Würenlingen are dealt with. The many problems that demand solution and the requirements that have to be met in connection with the design and construction of reactor plants are discussed, with particular reference to the concrete structures and the welding work that has to be carried out. (auth)

21171

FUEL ELEMENTS OF THE SWISS REACTOR DIORIT. K. H. Buob (Reaktor A. G., Würenlingen, Switzerland). Neue Technik 1, No. 6, 3-10(1959) Oct. (In German)

The construction and the fabrication of the fuel elements for the Swiss heavy water test reactor Diorit are discussed. Firstly, some fundamental problems concerning the fabrication of nuclear fuel elements are taken in consideration. Starting with an uranium dingot of 1.5 tons, rods of 2273 mm are fabricated by a forging and rolling process. In order to improve the irradiation stability, the elements are β-heat treated. Metallographic and thermal cycling tests are discussed. The rods are sheathed with aluminum of 1.5 mm thickness and welded at both ends. The integrity of the canning was tested in a glycol leak detector. The fabrication of these fuel elements constitutes an example of international collaboration in the field of nuclear energy. (auth)

21172

THE PILE OSCILLATOR OF THE SAPHIR SWIMMING-POOL REACTOR. T. Hürlimann, P. Schmid, and H. Winkler (Reaktor A. G., Würenlingen, Switzerland). Neue Technik 1, No. 7, 3-8(1959) Nov. (In German)

The oscillator at Saphir is described. Its accuracy is determined mainly by reactor noise. The use of a swimming-pool type reactor enables the necessary favorable positioning of the ionization chamber. Among others, the use of an "absorption counter-poise" and the calibration of the sensitivity by means of a three-piece absorber set is new. The square wave demodulation is weighted according to binominal coefficients. (auth)

21173

STUDY OF THE PROTECTIVE SHIELDING AT SAPHIR. J.-M. Pictet (Reaktor S. A., Würenlingen, Switzerland). Neue Technik 1, No. 7, 9-14(1959) Nov. (In French)

The problems of protection against radiation are presented. A description of the various attenuation processes of neutrons and γ rays in matter is also given. The general method for the study of reactor shields is then discussed; this method is based on theory as well as experiment. The experimental setup for shielding studies at the Saphir reactor is described together with the methods of measurement; experiments already performed are briefly mentioned. (auth)

21174

IMPROVED HOMOGENEOUS NUCLEAR REACTORS. (to Esso Research and Engineering Co.). British Patent 837,848. June 15, 1960.

Neutron fluxes from a homogeneous reactor can be increased from a previous maximum of 3×10^{13} to 10^{17} n/cm^2sec by designing the shell with a plurality (≥ 4) of conduits for liquid fuel passage and with a total conduit cross section of 2.5 times the maximum interior cross section area of the shell. Each pair of inlet and outlet lines has one or more heat exchangers, since the cooling means should have a maximum capacity of up to 10^9 Btu/hr. In this way, liquid fuel flow is increased so that neutron fluxes can be increased while maintaining subcriticality outside the shell. Variants of the reactor design with a fixed fissionable substance are also described. (D.L.C.)

WASTE DISPOSAL AND PROCESSING

21175 CEA-1437

France. Commissariat a l 'Energie Atomique. Centre d 'Etudes Nucleaires de Saclay.

LE TRAITEMENT DES EFFLUENTS DU CENTRE D'ETUDES NUCLEAIRES DE SACLAY. (Treatment of Effluent at the Saclay Center for Nuclear Studies). G. Wormser. 1960. 26p.

The Centre d 'Etudes Nucléaires at Saclay has several installations from which liquid radioactive effluent is rejected, and it has been found necessary to construct a station for the purification of radioactive liquids and to settle various chemical, analytical and technological problems. The disposal possibilities at the center, the effluents produced at the center, the set-up for collecting effluent, treatment of the effluent, and results of these treatments are described. (auth)

21176 CF-60-5-40

Oak Ridge National Lab., Tenn.

STEADY STATE HEAT LOSSES FROM RADIO WASTE STORAGE TANKS IN OAK RIDGE NATIONAL LABORATORY TANK FARM. S. H. Jury. May 5, 1960. 20p. Contract [W-7405-eng-26]. OTS.

Six cylindrical radio waste storage tanks in an Oak Ridge National Laboratory tank farm are arranged in a rectangular array two tanks wide and three tanks long with a 60-ft distance between tank centers. The tanks are 50 ft in diameter and 13 to 15 ft tall. They are buried in the earth with five foot of cover soil. An electrical analog of the farm was constructed in order to determine the steady state heat loss rates from tanks at the boiling point, 230°F, to the winds over the earth with an average year round temperature of 60°F. The steady state heat loss rate per tank ranged from 4,000 to 44,000 Btu/hr depending upon the location of the tank and whether the soil was dry or moist. (auth)

21177 RADC-TR-60-114

Pfaudler Permutit Inc., Rochester, N. Y.

DISPOSAL OF RADIOACTIVE WASTES FROM NUCLEAR REACTORS IN THE ARCTIC. (A Final Engineering Report). Apr. 1960. 186p. Project Nos. G759-9001 and 6185. Contract AF30(602)-2011.

Handling and disposal of radioactive wastes from 0.5 to 70 Mw(e) nuclear power reactors operating in arctic regions were studied. Pressurized and boiling water reactors were the principal types covered. Results of the study will be used in design and selection policies concerning military applications of nuclear reactors in the Arctic. Litera-

ture on radioactive waste disposal, the Arctic, and power reactor wastes was reviewed. Waste disposition based on technical and economic evaluations, and consistent with current regulations, was resolved. Liquid waste effluents from the reactor and resulting from operating procedures are a high-active, high-purity stream, to be decontaminated by demineralization, and a low-active, low-purity waste, to be decontaminated by demineralization or evaporation, the former being preferred for small reactors. Nonactive diluent wastes are to be fully used for dispersal, this being dependent on local water supply. Spent resins from primary coolant and waste treatment demineralizers, evaporator sludges, incinerator ashes, and other solids are the radioactive wastes to be transported from the reactor site for ultimate disposal. Suggestions are made for use of unique features of the Arctic for local waste disposal, and recommendations for future related studies are included. (auth)

21178

DECONTAMINATION OF MATERIALS AND SITES. J. Pomarola (Centre d'Études Nucléaires, Saclay, France). Bull. inform. sci. et tech. (Paris) No. 39, 14-21(1960) Apr. (In French)

The norms of decontamination for inactive and hot sites are tabulated, and then the nature of radioactive contamination is briefly reviewed. The methods of decontamination can be classified as chemical, physical, and physicochemical. Each of these methods is described in some detail. Ultrasonic decontamination is also discussed. Organization and operation of special groups whose purpose is field work in decontamination at various nuclear installations are described. (J.S.R.)

21179

ACTUAL SOLUTIONS TO THE PROBLEM OF THE DISPOSAL OF RADIOACTIVE SOLID WASTES. P. Cerré (Centre d'Études Nucléaires, Saclay, France). Bull inform. sci. et tech. (Paris) No. 39, 22-30(1960) Apr. (In French)

The origin, classification, and activity of the solid wastes from the French nuclear program at Saclay and Grenoble are reviewed. Possible solutions for the surface, underground, and underwater storage are then described as an introduction to a survey of the actual solutions adopted. The installation at Saclay for the treatment of wastes is briefly described. (J.S.R.)

21180

THE RADIOACTIVE RESIDUES COMING FROM THE TREATMENT OF IRRADIATED FUEL. THEIR ECONOMIC INCIDENCE. Pierre Cohen (Centre d'Études Nucléaires, Saclay, France). Bull. inform. sci. et tech. (Paris) No. 39, 31-4(1960) Apr. (In French)

After a suitable burn-up in nuclear reactors, the irradiated fuels are removed, stored for the decay of short-lived isotopes, and then treated to recover the uranium and plutonium. The effect of the cost of the elimination of the radioactive residues on the cost/kwh of nuclear energy is estimated as a function of the increase of the quantity of radioactive wastes. The part of the price of nuclear kwh to be allocated to the treatment of irradiated fuel is considered. The quantity of fission to be produced in France in 1965 is estimated. The disposal of primary and secondary liquid wastes is then discussed. (J.S.R.)

21181

METHOD OF HANDLING RADIOACTIVE WASTE SOLUTIONS. (to U. S. Atomic Energy Commission). British Patent 837,967. June 15, 1960.

A method is reported for converting aqueous radioactive aluminum nitrate solutions into solids. This is accomplished by using a fluidized bed of Al_2O_3 particles in which $Al(NO_3)_3$ waste is sprayed, heating the bed to ~500°C, and removing Al_2O_3 containing radioactive material from the bottom of the bed. (W.L.H.)

DEPOSITORIES OF USAEC REPORTS IN NON-U.S. LIBRARIES

The libraries at the organizations listed below maintain collections of unclassified U. S. Atomic Energy Commission reports for reference use.

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atómica

AUSTRALIA
Canberra, Australian National Library
Sutherland, New South Wales, Australian Atomic Energy Commission

AUSTRIA
Vienna, Zentral Bibliothek der Physikalischen Institute der Universität
Vienna, International Atomic Energy Agency

BELGIUM
Brussels, Centre d'Etudes pour les Applications de l'Energie Nucléaire
Brussels, La Bibliotheque EURATOM

BRAZIL
Rio de Janeiro, Instituto Brasileiro de Bibliografia e Documentacao

BURMA
Rangoon, Union of Burma Applied Research Institute

CANADA
Hamilton, McMaster University
Ottawa, National Research Council Library
Vancouver, University of British Columbia

CEYLON
Colombo, University of Ceylon

CHILE
Santiago, Ministerio de Relaciones Exteriores

CHINA
Hsinchu, Formosa, National Tsing Hua University Library

COLOMBIA
Bogotá, Comisión de Energía Atomica de Colombia

COSTA RICA
San Pedro, University of Costa Rica Library

CUBA
Havana, Comisión de Energía Nuclear de Cuba

DENMARK
Risö, Danish Atomic Energy Commission

DOMINICAN REPUBLIC
Ciudad Trujillo, National Palace

ECUADOR
Quito, Escuela Politécnica Nacional

EGYPT
Cairo, Atomic Energy Commission

EL SALVADOR
San Salvador, Universidad Nacional, Facultad de Ingenieria

ENGLAND
Birmingham, Central Library
Bristol, Central Library
Kingston upon Hull, Central Library
Leeds, Central Library
Liverpool, Central Library
London, Central Library, Acton
London, Science Museum Library, South Kensington
Manchester, Central Library
Newcastle upon Tyne, Central Library
Nottingham, Public Libraries
Sheffield, Central Library

FINLAND
Helsinki, Teknillisen Korkeakoulun Kirjasto

FRANCE
Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay
Paris, Académie des Sciences
Paris, European Nuclear Energy Agency, O. E. E. C.

GERMANY
Berlin, Hahn-Meitner-Institut für Kernforschung Berlin
Frankfurt/Main, Gmelin-Institut
Munich, Technische Hochschule, Bibliothek

GHANA
Accra, University College of Ghana

GREECE
Athens, Greek Atomic Energy Commission

GUATEMALA
Guatemala, Comisión Nacional de Energía Nuclear

HAITI
Port au Prince, University of Haiti

HONDURAS
Tegucigalpa, Comisión Hondureña de Energía Atómica

ICELAND
Reykjavik, University of Iceland, Atomic Energy Library

INDIA
Bombay, Department of Atomic Energy

INTER-AMERICAN NUCLEAR ENERGY COMMISSION
Washington, D. C., Pan American Union

IRAN
Tehran, Tehran University Center for Nuclear Studies

IRAQ
Baghdad, Iraqi Atomic Energy Commission

IRELAND
Dublin, University College

ISRAEL
Tel Aviv, Israel Atomic Energy Commission

ITALY
Milan, Centro di Studi Nucleari di Ispra del C.N.R.N.
Rome, Comitato Nazionale per le Ricerche Nucleari

JAPAN
Tokyo, Science Section, Diet Library

KOREA
Seoul, Atomic Energy Research Institute

LEBANON
Beirut, American University

LUXEMBOURG
Luxembourg, Ministry of Transport and Electricity

MEXICO
Mexico, D.F., Comisión Nacional de Energía Nuclear

NETHERLANDS
The Hague, Reactor Centrum Nederland

NEW ZEALAND
Wellington, Department of Scientific and Industrial Research

NORTHERN IRELAND
Belfast, Department of Industrial and Forensic Science

NORWAY
Lillestrøm, Institutt for Atomenergi

PAKISTAN
Karachi, Atomic Energy Commission

PERU
Lima, Biblioteca Nacional

PHILIPPINE REPUBLIC
Manila, Philippine Atomic Energy Commission

POLAND
Warsaw, Biura Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej

PORTUGAL
Lisbon, Junta de Energía Nuclear

REPUBLIC OF THE CONGO
Leopoldville, Université Lovanium

SCOTLAND
Glasgow, Mitchell Library

SPAIN
Madrid, Junta de Energía Nuclear

SWEDEN
Stockholm, Atomenergi AB

SWITZERLAND
Geneva, United Nations Library
Zurich, Institut für Physik, Eidg. Technische Hochschule

THAILAND
Bangkok, Office of the Thai Atomic Energy Commission, Department of Science

TURKEY
Ankara, Turkish Atomic Energy Commission, Atomic Energy Library

UNION OF SOUTH AFRICA
Pretoria, Atomic Energy Board Library, Council for Scientific and Industrial Research

UNITED NATIONS
New York, N. Y., U.N. Headquarters

URUGUAY
Montevideo, Universidad de Montevideo

VENEZUELA
Caracas, Instituto Venezolano de Investigaciones Cientificas

VIET-NAM
Saigon, Office of Atomic Energy

YUGOSLAVIA
Belgrade, Federal Nuclear Energy Commission

TECHNICAL PROGRESS REVIEWS

The U. S. Atomic Energy Commission, Office of Technical Information, publishes an unclassified series of Technical Progress Reviews which provide concise summaries of current atomic developments. Issued quarterly, each of these Technical Progress Reviews digests and evaluates the latest findings in a specific area of nuclear technology and science. The Reviews also report on technology developed in military reactor and other classified AEC programs to the extent that the technology can be dissociated from sensitive military and production data.

The four journals published in this series are:

Nuclear Safety, W. B. Cottrell, editor, R. A. Charpie, advisory editor, and associates, Oak Ridge National Laboratory

Power Reactor Technology, Walter H. Zinn and associates, General Nuclear Engineering Corporation

Reactor Core Materials (covering solid material developments), R. W. Dayton, E. M. Simons, and associates, Battelle Memorial Institute

Reactor Fuel Processing, Stephen Lawroski and associates, Chemical Engineering Division, Argonne National Laboratory

Each journal may be purchased by subscription (domestic, $2.00 a year; foreign, $2.50 a year) or by individual issue (55¢) from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.